State of Connecticut
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Forty-ninth Report

OF THE

CONNECTICUT AGRICULTURAL EXPERIMENT STATION

NEW HAVEN, CONN.

3517

FOR THE YEAR

1925

PRINTED IN COMPLIANCE WITH STATUTE

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The Board of Control

The Tuttle, Morehouse & Taylor Company
New Haven, Conn.

CONNECTICUT AGRICULTURAL EXPERIMENT STATION

OFFICERS AND STAFF

(As of October 31, 1925)

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His Excellency, Governor John H. Trumbull, *ex-officio, President.*

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Forestry.	Walter O. Filley, *Forester in Charge.* H. W. Hicock, M.F., *Assistant Forester.* Miss Pauline A. Merchant, *Stenographer.*
Plant Breeding.	Donald F. Jones, S.D., *Geneticist in Charge.* P. C. Mangelsdorf, S.D., *Assistant Geneticist.*
Soil Research.	M. F. Morgan, M.S., *Agronomist in Charge.* George D. Scarseth, B.S., *Graduate Assistant.*
Tobacco Sub-station at Windsor.	Paul J. Anderson, Ph.D., *Pathologist in Charge.* N. T. Nelson, Ph.D., *Assistant Physiologist.*

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Report of the Board of Control

OF

THE CONNECTICUT AGRICULTURAL EXPERIMENT STATION

To His Excellency, John H. Trumbull, Governor of Connecticut:

The Board of Control of the Connecticut Agricultural Experiment Station herewith submits its forty-ninth report for the year ending October 31, 1925.

The Report of the Director (Bulletin No. 274) to the Board of Control of this Station includes a review of the year, the changes in staff, and other pertinent matters. This was distributed to the mailing list in January, 1926, and is also included herewith, making further detailed report unnecessary.

As parts of this report there are submitted twelve regular bulletins and the report of the Tobacco Station at Windsor. By special effort the "Fertilizer Report" was distributed December first, thus increasing its usefulness. A new edition of the "Spray Bulletin" met with much favorable comment. The new Feeding Stuffs law placed upon the station added duties, but no difficulty has been experienced, the manufacturers and jobbers coöperating in fine spirit.

An account of the Semi-Centennial is published as Bulletin 280 and contains reproductions of the portraits of Professor Johnson and Dr. Jenkins, which were presented to the station at that time.

The new greenhouse has proved of great value in our plant breeding and soils work, increasing the productiveness in these lines.

Under the Purnell Act, the station has undertaken a detailed study of the soils of the State and the relation of forest composition and growth to these soils. It is yet too soon to expect results but the work is progressing very satisfactorily.

All of which is respectfully submitted,

GEORGE A. HOPSON,
Secretary.

Report of the Treasurer

July 1, 1924—June 30, 1925

W. L. Slate, Jr., in account with The Connecticut Agricultural Experiment Station for the fiscal year ended June 30, 1925.

Receipts.

Balance on hand, *July 1, 1924:*			
State General (Current Expense Appropriation)		$5,895.18	
Miscellaneous Receipts		274.81	
			$6,169.99
State Appropriation (General or Current Expense)		$50,000.00	
" " (General) (Additions)		951.52	
" " (Food)		7,500.00	
" " (Insect Pest)		15,000.00	
" " (Insect Pest) (Additions) ...		2,808.74	
United States Appropriation (Hatch)		7,500.00	
" " " (Adams)		7,500.00	
Fertilizer Analysis Fees		14,500.00	
Lockwood Trust Fund (including sales of tree seedlings and Mt. Carmel Farm produce)		9,000.00	
		$114,760.26	
Miscellaneous Receipts:			
Sales of gasoline	$308.02		
Sales of automobile oil	21.43		
Mileage for use of automobiles	109.31		
Court fees	404.36		
Miscellaneous	16.71		
Interest on bank deposits	10.47		
		870.30	$115,630.56
			$121,800.55
Less Miscellaneous Receipts Deposited with State Treasurer			987.73
			$120,812.82

DISBURSEMENTS.

Salaries	$62,635.27	
Labor	11,796.31	
Stationery and Office Supplies	775.16	
Scientific Supplies (chemicals)	1,293.61	
" " (other laboratory)	947.00	
" " (photographic)	32.92	
Feeding Stuffs	56.50	
Insecticides, Fungicides, etc.	17.45	
Lumber and Small Hardware	38.06	
Miscellaneous Supplies	791.87	
Automobile Oil	194.08	
Food Samples	43.46	
Fertilizers	657.57	
Telegraph and Telephone	260.70	
Postage	216.60	
Travel (outlying investigations)	1,522.27	
" (meetings, etc.)	1,237.07	
" (gasoline)	963.16	
Freight, Express and Parcels Post	162.59	
Publications (bulletins, etc.)	114.71	
" (miscellaneous)	151.70	
Coal	3,247.69	
Gas and Electricity	1,906.17	
Water	250.75	
Furniture and Fixtures (new)	296.31	
" " " (repairs)	92.89	
Library (books and periodicals)	758.34	
" (binding)	386.70	
Scientific Equipment (new)	2,054.21	
" " (repairs)	31.19	
Automobiles (new)	1,071.00	
" (repairs)	664.83	
Tools, Machinery and Appliances (new)	237.68	
" " " " (repairs)	499.11	
New Buildings and Structures	4.50	
Buildings (repairs and alterations)	5,874.49	
Insurance (fire, burglary and automobile)	1,084.51	
Taxes	39.29	
Miscellaneous Contingent Expenses	438.98	
Total Disbursements (excluding Insect Pest)		*$102,846.70*
Insect Pest Fund Expenditures		17,615.92
		$120,462.62
Balance on hand, June 30, 1925:		
Insect Pest Appropriation (in hands of State Comptroller)		192.82
		$120,655.44
Miscellaneous Receipts (in hands of Station Treasurer)		157.38
		$120,812.82

REPORT OF

W. L. SLATE, Jr., Director

IN ACCOUNT WITH

Mosquito Elimination Appropriation

For the Fiscal Year Ending June 30, 1925

RECEIPTS.

Balance on hand, July 1, 1924 (Petty Cash Fund) ..	$ 500.00	
State Appropriation	6,000.00	
Additions to Appropriation (contributions and collections from towns)	4,188.12	
Total		$10,688.12

EXPENDITURES.

By the State Comptroller on vouchers submitted by W. L. Slate, Jr., Director:		
Salary	$2,366.66	
Labor	5,830.47	
Stationery and Office Supplies	8.80	
Chemical Supplies	2.01	
Photographic Supplies	.55	
Hardware Supplies	4.32	
Miscellaneous Supplies	53.82	
Oil for Mosquito Spraying	30.45	
Automobile Oil	4.25	
Telephone and Telegraph	4.65	
Travel	110.27	
Travel (gasoline)	97.79	
Express	2.00	
Furniture and Fixtures (new)	8.00	
Tools, Machinery and Appliances (new)	128.76	
" " " " (repairs) ...	16.45	
Automobile repairs and accessories	122.75	
Tide Gates and Culverts (new)	155.31	
" " " " (repairs)	1,201.39	
Insurance (automobile)	39.42	
	$10,188.12	
Balance on hand July 1, 1925 (Petty Cash Fund) ...	500.00	
		$10,688.12

REPORT OF

W. L. SLATE, Jr., Director

UNDER THE

Tobacco Research Act

(Public Acts, 1921. Chap. 184)

For the Fiscal Year Ending June 30, 1925

RECEIPTS.

State Appropriation	$10,000.00	
Additions to Appropriation (sales of tobacco)	5,369.92	
Total		$15,369.92

EXPENDITURES.

Salaries	$3,399.99	
Labor	5,747.26	
Stationery	190.58	
Chemicals and Laboratory Supplies	12.86	
Feeding Stuffs	81.59	
Lumber for repairs, and small hardware	101.61	
Insecticides	217.82	
Sundry Supplies	1,043.82	
Automobile Oil	16.60	
Fertilizer	615.37	
Telephone	92.98	
Postage	17.56	
Travel	607.90	
" (gasoline)	76.31	
Garage rent	55.00	
Freight, Cartage and Express	66.53	
Heat ($381.51), Light ($41.23) and Water ($10.53)	433.27	
Furniture and Fixtures (new)	299.10	
Library	3.00	
Tools, Machinery and Appliances (new)	314.54	
" " " " (repairs)	7.35	
Automobile repairs	228.29	
Buildings and Land (new)	905.21	
" " " (repairs and alterations)	752.52	
Insurance	82.86	
		$15,369.92

BULLETIN 270 OCTOBER, 1925

Connecticut Agricultural Experiment Station
New Haven, Connecticut

Report on Inspection of Commercial Fertilizers for 1925

E. M. BAILEY, *Chemist in Charge of the Analytical Laboratory.*

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The Bulletins of this Station are mailed free to citizens of Connecticut who apply for them, and to other applicants as far as the editions permit.

CONNECTICUT AGRICULTURAL EXPERIMENT STATION

OFFICERS AND STAFF

October, 1925

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Tobacco Sub-station at Windsor.	Paul J. Anderson, Ph.D., *Pathologist in Charge.* N. T. Nelson, Ph.D., *Assistant Physiologist.*

THE TUTTLE, MOREHOUSE & TAYLOR COMPANY

Report on Inspection of Commercial Fertilizers, 1925

E. M. Bailey,

Chemist in Charge, Analytical Laboratory.

THE FERTILIZER LAW.

The provisions of the fertilizer law have been discussed in previous reports but for more ready reference the essential features may be repeated.

Significance of the Term "Commercial Fertilizers"

Explaining what is meant by the term "commercial fertilizers" the law says:

"The term 'commercial fertilizers' shall be construed to mean any and every substance imported, manufactured, prepared or sold for fertilizing or manuring or soil amendment purposes, except barnyard manure and stable manure which have not been artificially treated or manipulated, marl and lime. Cottonseed meal, rapeseed meal, castor pomace and all other vegetable products used as fertilizers, including the ashes of cotton hulls and wood ashes, shall be included as fertilizers within the meaning of this act and separate analysis fees shall be paid on each different grade which is sold or offered for sale in the state. The person responsible for paying the fees above prescribed may deduct from the total tonnage sold such sales of cottonseed meal or other vegetable products as are made to anyone who gives a written certificate on a form supplied by the Connecticut Agricultural Experiment Station stating that the material bought by him was to be used exclusively for feed and not for fertilizer."

Concerning Cottonseed Meal.

Cottonseed meal is a fertilizer within the meaning of the Statute but it is provided that when this product is sold for feeding purposes only, it shall be exempt from the tonnage tax.

The status of cottonseed meal under the fertilizer law has been clearly stated in a bulletin[1] from this Station from which the following may be quoted:

Registration and analysis fees. "Each brand of cottonseed meal must be registered on forms provided by this Station and an analysis fee of ten dollars paid on it before it is sold, offered or exposed for sale, and on the first day of January annually thereafter."

[1] *Bull. of Information No. 9, 1919.*

"A distinctive name constitutes a distinct brand. If shipments have different guaranties of composition they are held to be different brands."

Branding or tagging. "Since nitrogen is the only fertilizer ingredient considered in the trade in cottonseed meal no guaranty of phosphoric acid or potash is required. If either is guaranteed by the manufacturer, however, an additional fee of ten dollars must be paid on each element. The statement of composition now legal for feeds may be used hereafter if the percentage of nitrogen is stated.

"Note that the law regarding feeding stuffs forbids the use of metal in attaching tags and requires that each package shall be branded or tagged with the statement required by law."

Duties of shippers. "It is assumed from correspondence with shippers outside the state that they will register the brands which they sell in Connecticut, will pay analysis fees as has been done in the past by manufacturers of commercial fertilizers, and will semi-annually thereafter pay the tonnage fees.

"They will report to this Station their total sales and if they wish, may report what part has been sold for feed exclusively. From the reports of dealers within the state it will be possible to determine quite closely the amounts of each brand actually used as feed.

"In the case the jobber outside the state neglects or refuses to register a brand, the dealer who sells it within the state is responsible under the law."

Duties of dealers. "Dealers are required to file with the director of the Station on July first of each year and semi-annually thereafter a sworn statement of their total sales of each brand of cottonseed meal and the amount of each sold exclusively for feed, during the preceding six months."

Requirements to be Complied with by Sellers of Commercial Fertilizers.

The seller is responsible for the proper labeling of each package, for the registration at the Station of every brand sold by him and for the payment of the analysis fee, before offering for sale, and annually thereafter on January 1st.

The law specifies the information which shall be given on the label as follows:

1. *Weight of each package in pounds.*
2. *Brand name or trade mark.*
3. *Analysis:*
    (a) *Available phosphoric acid, per cent.*
    (b) *Total phosphoric acid, per cent.*
    (c) *Nitrogen, per cent.*
    (d) *Equivalent ammonia, per cent.*
    (e) *Potash soluble in water, per cent.*

4. *Name and address of the manufacturer or of the person who is responsible for the statement of the guaranty.*

In the case of bone meal, tankage or other organic products, and in basic slag and mineral phosphates in which a large percentage of the phosphoric acid is not available by laboratory methods, the

phosphoric acid shall be claimed as total phosphoric acid unless it is desired to claim available phosphoric acid instead, in which case the guaranty shall take the form set forth above.

The label may be a tag attached to the package or a statement printed thereon. Percentages shall be minimum percentages only.

The presence of leather in its various forms, wool waste, hair, or any inert nitrogenous material shall be declared on the label unless, by processing, the activity of these materials has been rendered satisfactory as determined by official methods.

When potash is derived from sulphate or carbonate of potash it may be so claimed.

No claim or guaranty for less than 0.82 per cent of nitrogen or for less than 1 per cent of phosphoric acid, or for less than 1 per cent of potash shall be regarded in the registration or analysis of any commercial fertilizer.

The seller must also, on the 1st of January and July, report the tonnage of fertilizer sold within the preceding six months and pay to the director of the Station a tonnage fee of 6 cents per ton.

On request, copies of the law and blanks for registration and for tonnage reports will be supplied by the Station.

If, however, proper labeling, registration and payments have been provided for by the manufacturer of the brands or by another responsible person all sellers of such brands are released from the above mentioned requirements. The retailer, therefore, should assure himself that the requirements of the law have been met by the manufacturers of the brands which he handles, or himself be prepared to meet all these requirements.

Precautions to be Observed in Drawing Samples for Analysis.

The analysis of a fertilizer is of no value unless the sample analyzed represents as nearly as possible the stock from which the sample was drawn. The law prescribes the procedure to be followed by authorized agents of this Station when taking official samples for analysis as follows:

"When samples are taken from fertilizers in bags, a tube shall be used, and it shall be inserted at one end of the bag and shall pass substantially the entire length of the bag, so as to take a core of the material being sampled from substantially the entire length of the bag. Samples thus taken from individual bags shall be thoroughly mixed, and the official samples shall be taken from the mixture so drawn by the method known as 'quartering.' Samples of fertilizers taken as herein provided shall be taken from at least five per centum of the separate original unopened packages in the lot, for the mixture from which the official samples shall be taken. If less than one hundred bags are in the lot, at least five bags shall be sampled; if less than five bags, all shall be sampled. Broken packages shall not be sampled."

Gratuitous Analyses.

Under the fertilizer law the Station is charged only with the analysis of samples drawn by its own agents. It does, however, each year analyze a considerable number of samples drawn by individuals, representing stock purchased by them for their own use. The object of the purchaser is to satisfy himself as to whether he has obtained goods of the grade represented and, perhaps, to obtain evidence upon which to base a claim for shortage should the materials not meet their guaranties. The Station assumes no responsibility for the sampling in case of such unofficial samples and can only vouch for the accuracy of the results obtained on the materials as submitted. Since a representative sample is as essential as an accurate analysis in judging the quality of a shipment of fertilizer, it is evident that a satisfactory adjustment will seldom be effected on the basis of an unofficial sample. Notwithstanding certain objections which may be raised to the practice of analyzing samples submitted by individuals, the Station is disposed to continue such work so long as there is evidence that it constitutes a useful service; it cannot, however, undertake for any one individual or group, work in such volume or with such frequency that it becomes a systematic control over current purchases. This clearly invades the field of the commercial laboratory.

REGISTRATIONS.

For 1925, 61 individuals and firms registered at this Station for sale in this State 437 brands of fertilizers. As required by Statute the brands so registered are listed as follows:

American Agricultural Chemical Co., 40 West St., New York, N. Y.

Castor Pomace
Complete Potato Mixture
Crescent Complete Manure
Double A Tobacco Fertilizer
Dry Ground Fish
Farm Favorite
Fine Ground Bone
Fish and Potash
Grass and Lawn Top Dressing
Ground Tankage
High Grade Acid Phosphate
Hi-Grade Tobacco Manure
Nitrate of Soda
7% Potash Fertilizer
Pulverized Sheep Manure
Sulphate of Potash
Universal Phosphate
Bowker's Lawn and Garden Dressing
Bradley's Complete Manure for Potatoes and Vegetables
Bradley's Complete Tobacco Manure

Bradley's Corn Phosphate
Bradley's New Method Fertilizer
Bradley's Northland Potato Grower
Bradley's Potato Fertilizer
Bradley's Potato Manure
Bradley's Superior Tobacco Compound
Bradley's XL Superphosphate of Lime
National Complete Tobacco Fertilizer
National Eureka Potato Fertilizer
National Market Garden Fertilizer
National Potato and Corn Phosphate
National Premier Truck Manure
National White Ash Tobacco Grower
National XXX Fish and Potash
Quinnipiac Corn Manure
Quinnipiac Fish and Potash Phosphate
Quinnipiac Market Garden Manure
Quinnipiac Potato Phosphate
Quinnipiac Prime Tobacco Manure
Quinnipiac Seed Leaf Tobacco Manure

American Cyanamid Co., 511 Fifth Ave., New York, N. Y.
Ammo-Phos

Apothecaries Hall Co., Waterbury, Conn.
Acid Phosphate
Animal Tankage
Bone
Bone and Meat Tankage
Bone Meal
Carbonate Potash
Castor Pomace
Cottonseed Meal 41%
Double Sulphate Potash and Magnesia
Dry Ground Fish
Nitrate Soda
Nitrate Soda and Potash
Potash Muriate
Potash Sulphate
Precipitated Bone
Sulphate Ammonia
Liberty Corn and All Crops 2-8-2
Liberty Corn and Vegetable 3-6-10
Liberty Corn, Fruit and All Crops 2-12-4
Liberty Fish, Bone and Potash 3-10-4
Liberty High Grade Market Gardeners 5-8-7
Liberty High Grade Tobacco Manure 7.5-4-7.5
Liberty Market Gardeners Special 4-8-4
Liberty Tobacco Special 5-4-5
Liberty Top Dresser for Grass and Grain 10-3.5-8

Armour Fertilizer Works, 50 Broad St., New York, N. Y.
Armour's Big Crop Acid Phosphate 16%
Armour's Big Crop Fertilizer 8-6-6
Armour's Big Crop Fertilizer 5-8-7
Armour's Big Crop Fertilizer 5-8-5
Armour's Big Crop Fertilizer 4-16-4

Armour's Big Crop Fertilizer 4-6-10
Armour's Big Crop Fertilizer 4-8-4
Armour's Big Crop Fertilizer 3-8-4
Armour's Big Crop Fertilizer 2-12-2
Armour's Big Crop Tobacco Special 5-4-5
Armour's Corn Grower 2-8-2
Bone Meal 3-48
Ground Tankage 9-15
Muriate of Potash 48%
Nitrate of Soda 18%
Sheep Manure 1.5-1-2

Ashcraft-Wilkinson Co., Trust Co. of Georgia Bldg., Atlanta, Ga.
Helmet Brand Prime Cottonseed Meal
Monarch Brand Prime Cottonseed Meal
Paramount Brand Good Cottonseed Meal

Atlantic Packing Co., New Haven, Conn.
Atlantic 5-8-7
Atlantic Corn and Grain Fertilizer 2-8-2
Atlantic Market Garden 4-8-6
Atlantic Special 3-8-4
Atlantic Special Tobacco Fertilizer 5-4-16
Atlantic Special Vegetable and Potato Grower 4-8-4
Atlantic Tobacco Grower 5-4-5
Atlantic Tobacco Manure 5-8-6

Baker Castor Oil Co., 120 Broadway, New York, N. Y.
Castor Pomace

Barrett Co., 40 Rector St., New York, N. Y.
Arcadian Sulphate of Ammonia

F. A. Bartlett Tree Expert Co., Stamford, Conn.
Bartlett's Green Tree Food

Berkshire Fertilizer Co., Bridgeport, Conn.
Berkshire Castor Pomace
Berkshire Complete Fertilizer
Berkshire Complete Tobacco
Berkshire Dry Ground Fish
Berkshire Economical Grass Fertilizer
Berkshire Fine Ground Bone
Berkshire Grass Special
Berkshire Long Island Special
Berkshire Market Garden
Berkshire Potato and Vegetable Phosphate
Berkshire Tobacco Special
Berkshire Sheep Manure
Acid Phosphate
Double Manure Salt
Ground Tankage
High Grade Sulphate Potash
Muriate of Potash
Nitrate of Soda
Precipitated Bone Phosphate

F. E. Boardman, Middletown, Conn.
Boardman's Fertilizer for Potatoes and General Crops
Boardman's Tobacco Fertilizer

Bowker Fertilizer Co., 60 Trinity Place, New York, N. Y.
Bowker's All Round Fertilizer
Bowker's Fisherman's Brand Fish and Potash
Bowker's Hill and Drill Phosphate
Bowker's Market Garden Fertilizer
Bowker's Potato and Vegetable Phosphate
Bowker's Square Brand Farm and Garden Phosphate
Bowker's Sure Crop Phosphate
Stockbridge Early Crop Manure
Stockbridge Potato and Vegetable Manure
Stockbridge Premier Tobacco Grower
Stockbridge Tobacco Manure
Stockbridge Top Dressing and Forcing Manure
Stockbridge Truck Manure

Bridge's Sons, Inc., Amos D., Hazardville, Conn.
Corn, Onion and Potato and General Purpose
Special Tobacco Fertilizer

Buckeye Cotton Oil Company, Cincinnati, Ohio.
"Buckeye" 36% Protein Cottonseed Meal
"Buckeye" 41% Protein Cottonseed Meal

A. H. Case & Co., Inc., Buffalo, N. Y.
Case's Brand of Pulverized Sheep Manure

Chittenden Co., E. D., Bridgeport, Conn.
Chittenden's Castor Pomace
Chittenden's Complete Grain
Chittenden's Dry Ground Fish
Chittenden's Fine Ground Bone
Chittenden's High Grade Acid Phosphate
Chittenden's High Grade Muriate Potash
Chittenden's High Grade Potato
Chittenden's High Grade Sulphate Potash
Chittenden's High Grade Tobacco
Chittenden's Nitrate of Soda
Chittenden's Potato Special 4-8-4
Chittenden's Potato Special 4-8-6
Chittenden's Tobacco Special
Chittenden's Top Dresser 5-8-4

Clark Seed Co., Everett B., Milford, Conn.
Clark's Special Mixture for General Use
Clark's Special Mixture with 6% Potash
Clark's Superphosphate
Clark's Tip Top Brand
Acid Phosphate
Bone
Muriate of Potash
Nitrate of Soda
Tankage

Connecticut Fat Rendering & Fertilizer Corporation, West Haven, Conn.

Tankage

Consolidated Rendering Co., 40 North Market St., Boston (9), Mass.

Acid Phosphate 16%
Castor Pomace
Dry Ground Fish
Ground Bone (2.5-25.18)
Ground Bone (2.46-3)
Muriate of Potash
Nitrate of Soda
Tankage 9-20
Tankage 6-30
Sulphate of Ammonia
Sulphate of Potash

Davey Tree Expert Co., Kent, Ohio.

Davey Tree Food

Davis, S. P., 207 Southern Trust Bldg., Little Rock, Ark.

Beauty Brand Cottonseed Meal
Goodluck Brand Cottonseed Meal and Cracked Screened Cottonseed Cake
Steerboy Brand Cottonseed Meal and Cracked Screened Cake

Eastern Cotton Oil Co., Norfolk, Va.

Superior Cottonseed Meal

Eastern States Farmers' Exchange, 33 Lyman St., Springfield, Mass.

Eastern States 8-6-6
Eastern States 5-10-5
Eastern States 5-8-7
Eastern States 4-8-10
Eastern States 4-8-4
Eastern States 3-12-3
Eastern States Acid Phosphate
Eastern States Fine Ground Bone
Eastern States Formula "A" Tobacco Fertilizer
Eastern States Formula "B" Tobacco Fertilizer
Eastern States Formula "C" Tobacco Fertilizer
Eastern States Ground Animal Tankage
Eastern States Kainit
Eastern States Muriate of Potash
Eastern States Nitrate of Soda
Eastern States Sulphate of Ammonia
Sulphate of Potash

Essex Fertilizer Co., 39 North Market St., Boston, Mass.

Essex 2-8-2 for Farm and Garden
Essex Fish Fertilizer for All Crops 3-8-4
Essex Market Garden for Potatoes, Roots and Vegetables 4-8-4
Essex Potato Phosphate 4-8-7 for Potatoes and Vegetables
Essex Special Tobacco 5-4-5
Essex Tobacco Manure 5-8-6

Frisbie Co., L. T., New Haven, Conn.
Frisbie's 5-8-7
Frisbie's Corn and Grain Fertilizer 2-8-2
Frisbie's Fine Bone Meal
Frisbie's 3/50 Bone Meal
Frisbie's 12/10 Ground Tankage
Frisbie's Market Garden 4-8-6
Frisbie's Special 3-8-4
Frisbie's Special Vegetable and Potato Grower 4-8-4
Frisbie's Tobacco Grower 5-4-5
Frisbie's Manure 5-8-6
Frisbie's Top Dresser 7-5-4
Precipitated Bone

Higgins, Inc., A. W., South Deerfield, Mass.
Old Deerfield Acid Phosphate
Old Deerfield Castor Pomace
Old Deerfield 5-8-7 Complete Fertilizer
Old Deerfield 4-8-4 Complete Fertilizer
Od Deerfield Manure Salts
Old Deerfield Muriate of Potash
Old Deerfield Tankage

Humphreys-Godwin Co., Inc., Memphis, Tenn.
Bull Brand Cottonseed Meal 43%
Danish Brand Cottonseed Meal 36%
Dixie Brand Cottonseed Meal 41.12%

International Agricultural Corporation, **126 State St., Boston, Mass.**
International Acid Phosphate
International Connecticut Valley Special
International Crop Grower
International Economy
International General Favorite
International High Grade Manure
International Ideal
International Multiple-Strength
International New England Special
International Phosphate and Potash
International Tobacco Grower
International Tobacco Producer
International Tobacco Special
Bone Meal
Castor Pomace
Cotton Seed Meal
Muriate of Potash
Nitrate of Soda
Sulphate of Ammonia
Sulphate of Potash
Tankage

Joynt, John, Lucknow, Ontario, Canada.
The Joynt Brand Unleached Hardwood Ashes

Kellogg & Sons, Inc., Spencer, Buffalo, N. Y.
Castor Pomace

Lovitt & Co., L. B., Memphis, Tenn.
Lovit Brand Cottonseed Meal 36%
Lovit Brand Cottonseed Meal 41%
Lovit Brand Cottonseed Meal 43%

Lowell Fertilizer Co., 40 North Market St., Boston, Mass.
Lowell Animal Brand, A High Grade Manure for All Crops 3-8-4
Lowell Bone Fertilizer, for Corn, Grain, Grass and Vegetables 2-8-2
Lowell Potato Phosphate for Potatoes and Vegetables 4-8-7
Lowell Tobacco Manure 5-8-6
Lowell Tobacco 5-4-5 Tobacco, Fruits and Vines
Lowell Top Dressing 7-5-2
Lowell 5-8-7 for Potatoes and Vegetables
Lowell 4-8-4 for Potatoes, Corn and Vegetables
Lowell 4-6-10 for Potatoes and Vegetables

Mapes Formula & Peruvian Guano Co., 270 Madison Ave., New York N. Y.
The Mapes Connecticut Valley Special
The Mapes Corn Manure
The Mapes General Tobacco Manure
The Mapes General Truck Manure
The Mapes General Use Manure
The Mapes Grain Brand
The Mapes Onion Manure
The Mapes Potato Manure
The Mapes Tobacco Ash Constituents
The Mapes Tobacco Manure, Wrapper Brand
The Mapes Tobacco Starter Improved
The Mapes Top Dresser
The Mapes Special Formula Tobacco Manure

Memphis Cottonseed Products Co., 1015 Falls Bldg., Memphis, Tenn.
Durham Brand 36% Cottonseed Meal
Durham Forty Three Cottonseed Meal

National Cottonseed Products Corp., Memphis, Tenn.
Sun Brand Cottonseed Meal

Natural Guano Company, Aurora, Ill.
"Sheep's Head" Pulverized Sheep Manure

New England By-Products Corp., 20 West St., Lawrence, Mass.
Pure Bone Meal
Ground Steam Bone

New England Fertilizer Co., 40A North Market St., Boston, Mass.
New England 5-8-7 for Potatoes and Market Gardens
New England 4-8-4 for Potatoes, Vegetables and Grass
New England Corn Phosphate for Grain and Vegetables 2-8-2
New England Potato Phosphate 4-8-7 for Potatoes and Vegetables
New England Superphosphate, A High Grade Fertilizer for All Crops 3-8-4
New England Tobacco Manure 5-8-6
New England Tobacco 5-4-5

Nitrate Agencies Co., Baltimore, Md.

Naco Brand Acid Phosphate
Naco Brand Dry Ground Fish
Naco Brand Muriate of Potash
Naco Brand Nitrapo

Olds & Whipple, Inc., Hartford, Conn.

O & W Acid Phosphate
O & W Blue Label Tobacco Fertilizer
O & W Castor Pomace
O & W Complete Corn, Potato and Onion Fertilizer
O & W Complete Tobacco Fertilizer
O & W Dry Ground Fish
O & W High Grade Potato Fertilizer
O & W H. G. Starter and Potash Compound
O & W High Grade Tobacco Starter
O & W Precipitated Bone
O & W Pure Bone Meal
O & W Special Comp. Corn, Onion and Potato Fertilizer
O & W Top Dressing for Grass
Double Manure Salts
H. G. Sulphate of Potash
Nitrate of Soda

Pacific Manure & Fertilizer Co., 429 Davis St., San Francisco, Cal.

Groz-It Brand Pulverized Sheep Manure

Parmenter & Polsey Fertilizer Co., 41 North Market St., Boston, Mass.

Parmenter & Polsey 5-8-7 for Potatoes and Market Gardens
Parmenter & Polsey 4-8-4 for Potatoes, Corn and Vegetables
"P & P" 2-8-2 for Farm and Garden
"P & P" Plymouth Brand for All Crops 3-8-4

Piedmont Mt. Airy Guano Co., Baltimore, Md.

Piedmont Bone Meal
Harvest Brand 16% Acid Phosphate
Harvest Brand 8-6-6
Harvest Brand 6-8-6
Harvest Brand 5-8-7
Harvest Brand 5-8-5
Harvest Brand 4-8-4
Harvest Brand 4-6-10
Harvest Brand 3-8-4
Harvest Brand 2-8-2
9% Tankage
Muriate of Potash
Nitrate of Soda
Sulphate of Ammonia

Platt Co., Frank S., 450 State St., New Haven, Conn.

Platco Special

Potash Marl, Inc., 13 East 40th St., New York, N. Y.

Potash-Marl

Premier Poultry Manure Co., 431 So. Dearborn St., Chicago, Ill.

Premier Brand Pulverized Poultry Manure
Premier Brand Pulverized Sheep Manure

Pulverized Manure Co., 828 Exchange Ave., Union Stock Yards, Chicago, Ill.

Wizard Brand Manure
Wizard Brand Sheep Manure

Rackliffe Bros. Co., Inc., New Britain, Conn.

4-8-4 Fertilizer
Nitrate of Soda
"M. F. E." Brand Nitrate of Soda

Rogers & Hubbard Co., The, Portland, Conn.

Rogers & Hubbard's All Soils-All Crops Fertilizer
Rogers & Hubbard's Climax Tobacco Brand
Rogers & Hubbard's Corn and Grain Fertilizer
Rogers & Hubbard's High Potash Fertilizer
Rogers & Hubbard's Potato Fertilizer
Rogers & Hubbard's Tobacco Grower, Vegetable Formula
Hubbard's "Bone Base" Fertilizer for Oats and Top Dressing
Hubbard's "Bone Base" Fertilizer for Seeding Down
Hubbard's "Bone Base" Soluble Corn and General Crops Manure
Hubbard's "Bone Base" Soluble Potato Manure
Hubbard's "Bone Base" Soluble Tobacco Manure
Hubbard's Pure Raw Knuckle Bone Flour
Hubbard's Strictly Pure Fine Bone
5-8-7
4-8-4
Acid Phosphate
Castor Pomace
Cottonseed Meal
Garden Fertilizer
Ground Fish
Nitrate of Soda
Precipitated Bone
48% Sulphate of Potash

Royster Guano Co., F. S., 1606 Munsey Bldg., Baltimore, Md.

Royster's *16% Acid Phosphate*
Royster's Bully Guano
Royster's Fine Ground Bone Meal
Royster's Quality Trucker
Royster's Top Dresser
Royster's Triumph Guano
Royster's Truckers Delight
Royster's Valley Tobacco Formula
Royster's Verbena Guano
Royster's Wrapper Brand
Muriate of Potash
Nitrate of Soda
Sulphate of Ammonia

Sanderson Fertilizer & Chemical Co., New Haven, Conn.

Sanderson's Acid Phosphate
Sanderson's Atlantic Coast Bone, Fish and Potash
Sanderson's Castor Pomace

Sanderson's Complete Tobacco Grower
Sanderson's Corn Superphosphate
Sanderson's Dry Ground Fish
Sanderson's Fine Ground Bone
Sanderson's Formula A
Sanderson's Formula B
Sanderson's Nitrate of Soda
Sanderson's Potato Manure
Sanderson's South American Sheep and Goat Manure
Sanderson's Top Dressing for Grass and Grain

Shoemaker & Co., Inc., M. L. Venango St. and Delaware Ave., Philadelphia, Pa.

"Swift-Sure" Bone Meal 5.5-45
"Swift-Sure" Crop Grower
"Swift-Sure" Special Tobacco Formula
"Swift Sure" Tobacco and General Use
"Swift Sure" Tobacco Starter
Acid Phosphate
Bone Meal 3-50

Springfield Rendering Co., Springfield, Mass.

Springfield Animal Brand 3-8-4
Springfield Market Garden Grower and Top Dresser 5-8-7
Springfield Special Potato, Onion and Vegetable 4-8-4
Springfield Tobacco Special 5-4-5

Thomas & Sons Co., I. P., Philadelphia, Pa.

I. P. Thomas 5-8-7
16% Acid Phosphate
Improved Trucker's Fertilizer 5-10-5
Muriate of Potash
Nitrate of Soda
Pure Ground Bone
Tankage
Truckers' High Grade Guano 4-8-4

Triton Oil & Fertilizer Co., 101 Beekman St., New York, N. Y.

Triton 5-8-7 Fertilizer
Triton 4-8-7 Fertilizer
Triton 4-8-4 Fertilizer
Triton 3-10-2 Fertilizer
Acid Phosphate

United States Guano Co., c/o Standard Wholesale Phosphate Acid Works, Baltimore, Md.

Standard United States 16% Acid Phosphate
Standard United States Bone Meal
Standard United States Evergreen Fish Guano
Standard United States Farmers Formula
Standard United States Fish, Bone and Potash
Standard United States Muriate of Potash
Standard United States Nitrate of Soda

Virginia-Carolina Chemical Co. (of Delaware), Equitable Bldg., 120 Broadway (Room 2249), New York, N. Y.

V-C Aroostook Potato Grower
V-C Champion Brand
V-C Double Owl Brand
V-C Good Luck Brand
V-C Indian Chief Brand
V-C National Brand
V-C Tip Top-Top Dresser

Vitogro Chemical Co., 38 Middle St., Lowell, Mass.

Vitogro for Flowers, Shrubs and Vegetables

Wilcox Fertilizer Works, 56 Main St., Mystic, Conn.

Wilcox 5-10-5 Fertilizer
Wilcox 5-8-7 Fertilizer
Wilcox 4-8-4 Fertilizer
Wilcox Corn Special
Wilcox Dry Ground Fish
Wilcox Fish and Potash
Wilcox Grass and Truck Fertilizer
Wilcox Potato and Vegetable Phosphate
Wilcox Top Dresser
Wilcox Tobacco Special
Acid Phosphate
Nitrate of Soda
Steamed Bone Meal

Woodruff & Sons, S. D., Orange, Conn.

Woodruff's Home Mixed Fertilizer

Worcester Rendering Co., Auburn, Mass.

Prosperity Brand Complete Dressing
Prosperity Brand Corn and Grain Fertilizer
Prosperity Brand Ground Tankage
Prosperity Brand Market Garden Fertilizer
Prosperity Brand Potato and Vegetable Fertilizer
Prosperity Brand Superior Top Dressing

INSPECTION OF 1925.

During the season our agent has visited 97 towns and drawn 601 official samples of mixed fertilizers and raw materials, which number includes all the registered brands which were found on sale. These together with samples submitted by purchasers and others may be classified as follows:

CLASSIFICATION OF FERTILIZERS EXAMINED.

		Number of Samples	Page
I.	*Containing Nitrogen as the chief active ingredient:*		
	Nitrate of Soda	23	18
	Sulphate of Ammonia	5	20
	Castor Pomace	30	20
	Cottonseed Meal	53	24
II.	*Containing Phosphoric Acid as the chief active ingredient:*		
	Precipitated Bone Phosphate	10	27
	Dissolved Rock Phosphate or Acid Phosphate	24	28
III.	*Containing Potash as the chief ingredient:*		
	Carbonate of Potash	7	31
	Muriate of Potash	15	31
	Sulphate of Potash	14	31
	Double Sulphate of Potash and Magnesia	3	31
	Kainit	1	31
IV.	*Containing Nitrogen and Potash:*		
	Nitrate of Potash and Soda	1	35
	Nitrapo	1	35
V.	*Containing Nitrogen and Phosphoric Acid:*		
	Dry Ground Fish	26	35
	Tankage	16	38
	Ground Bone	26	40
VI.	*Mixed Fertilizers:*		
	Containing Nitrogen and Phosphoric Acid	4	43
	Containing Nitrogen, Phosphoric Acid and Potash	269	43
	Special and Home Mixtures	46	67
VII.	*Miscellaneous fertilizers, amendments, waste products, etc.:*		
	Wood Ashes	12	71
	Sheep Manure, etc.	11	74
	Lime, etc.	17	75
	Miscellaneous	76	78
	Total	690	

I. RAW MATERIALS CHIEFLY VALUABLE FOR NITROGEN.

NITRATE OF SODA

This salt in a pure state contains 16.47 per cent of nitrogen. Commercial grades usually contain from 15 to 16 per cent of nitrogen which is equivalent to 18.2 to 19.5 per cent of ammonia or 91 to 97 per cent of nitrate of soda.

Twenty-three samples have been analyzed and the results are given in Table I. So far as nitrogen guaranties were given no deficiencies were found. The average nitrogen content was 15.43 per cent which is equivalent to 18.76 per cent of ammonia.

At prices quoted, $60.00 to $85.00, nitrogen has cost from 19.2 to 27.2 cents per pound. *Excluding the single high quotation, the range is 19.2 to about 25 cents.* The average last year was found to be 23.3 cents.

TABLE I. ANALYSIS OF NITRATE OF SODA.

Manufacturer or Jobber.	Purchased, Sampled or Sent by	Per cent. Nitrogen. Found.	Per cent. Nitrogen. Guaranteed.
American Agricultural Chemical Co., New York	Station agent. Stock of F. S. Bidwell Co., Windsor Locks	15.48	15.00
Apothecaries Hall Co., Waterbury	Station agent. Stock of R. W. Hine, Cheshire	15.66	14.80
Armour Fertilizer Works, New York	Station agent. Stock of F. A. Bartlett Tree Expert Co., Stamford	15.30	14.81
Berkshire Fertilizer Co., Bridgeport	Station agent. Stock of T. W. Ryan, Stratford	15.46	15.00
E. D. Chittenden Co., Bridgeport	Station agent. Stock of E. J. Bantle, Glastonbury	15.02	15.00
Everett B. Clark Seed Co., Milford	Station agent. Stock of Jos. Adams, Southport	15.12	15.00
Consolidated Rendering Co., Boston	Station agent. Stock of L. T. Frisbie Co., New Haven	15.32	15.22
Consolidated Rendering Co., Boston	Station agent. Stock of A. E. Shedd, Norwich	15.50	15.00
Eastern States Farmers' Exchange, Springfield	Station agent. Stock of Edgewood Farm, North Haven	14.96	14.80
International Agricultural Corp., Woburn	Station agent. Stock of Geo. Adams, West Suffield	15.40	15.00
Olds & Whipple, Inc., Hartford	Station agent at factory	15.58	15.00
Piedmont Mt. Airy Guano Co., Baltimore	Station agent. Stock of Lightbourn & Pond Co., New Haven	15.38	15.02
Rackliffe Bros., New Britain	Station agent. Stock of The Meriden Farmers' Exchange, Meriden	15.60	15.00
Rackliffe Bros., New Britain	Station agent at factory	15.20	15.00
The Rogers & Hubbard Co., Portland	Station agent at factory	15.52	14.80
F. S. Royster Guano Co., Baltimore	Station agent. Stock of W. S. Brown, Trumbull	15.40	15.00
Sanderson Fertilizer and Chemical Co., New Haven.	Station agent at factory	15.90	15.00
I. P. Thomas & Son, Philadelphia	Station agent. Stock of Highwood Vegt. Growers' Association, Highwood	15.52	15.00
United States Guano Co., Baltimore	Station agent. Stock of Knowles-Lombard Co., Guilford	15.46	15.00
Wilcox Fertilizer Works, Mystic	Station agent. Stock of Jordan Hardware Co., Willimantic	15.14	15.00
W. R. Grace Co., New York.	American Sumatra Tobacco Co., Bloomfield	15.16	....
W. R. Grace & Co., New York	American Sumatra Tobacco Co., Bloomfield	15.68	....
....	T. J. Conine, Stratford	14.76	....

SULPHATE OF AMMONIA.

Pure sulphate of ammonia contains 21.2 per cent of nitrogen but the commercial grades contain about 20.5 per cent which is equivalent to about 25 per cent of ammonia or about 97 per cent of ammonium sulphate.

Five samples were examined and results are given in Table II. All substantially met or exceeded the guaranties for nitrogen. *Prices were not quoted but 17.5 cents per pound may be taken as a fair valuation for nitrogen from this source this year.*

TABLE II. SULPHATE OF AMMONIA.

Station No.	Manufacturer or Jobber.	Purchased, Sampled or Sent by	Per cent Nitrogen	
			Found.	[illegible]
2345	Apothecaries Hall Co., Waterbury	Station agent at factory	20.94	20
1521	The Barrett Co., New York	Station agent. Stock of T. W. Ryan, Stratford	20.96	20
1847	Consolidated Rendering Co., Boston	Station agent. Stock of A. E. Shedd, Norwich	20.46	20
1582	Consolidated Rendering Co., Boston	Station agent. Stock of L. T. Frisbie Co., New Haven	20.44	20
1905	Eastern States Farmers' Exchange, Springfield	Station agent. Stock of Henry Joy, Woodstock	20.80	20

CASTOR POMACE.

Castor pomace is the residue left after removing the oil from the castor bean. Because of its poisonous constituents it should be stored where farm animals cannot have access to it. While chiefly valuable for its nitrogen, it contains also about one per cent of potash and two per cent of phosphoric acid. It is used chiefly with cottonseed meal in tobacco mixtures.

Thirty samples were examined and are summarized in Table III. Thirteen were sampled by the station agent and the remainder were submitted by purchasers. Sample **1680** fell somewhat below its guaranty as did **1797**. In the latter case, however, while the purchaser stated 5.50 per cent of nitrogen as

the guaranty, the registration made by the dealer claimed only 5 per cent, according to which there was no deficiency.

The average guaranty was 4.61 per cent of nitrogen and the average found was 5.02 per cent. *Ton prices, where quoted, ranged from $23.00 to $36.00 and nitrogen therefore cost from 23.3 to 39.7 cents per pound. If allowance is made for potash and phosphoric acid at 4 cents per pound each the cost of nitrogen is 2 to 3 cents less.*

TABLE III. ANALYSES OF CASTOR POMACE.

Station No.	Manufacturer or Jobber, Car No. or Mark.	Purchased, Sampled or Sent by	Per cent. Nitrogen. Found.	Per cent. Nitrogen. Guaranteed.
	The American Agricultural Chemical Co., New York City.			
1719	59085	R. H. Daly, Broad Brook	4.54	4.5
2023		Station agent, from stock of C. F. Allen, Warehouse Pt.	5.05	4.5
	Apothecaries Hall Co., Waterbury, Conn.			
1612		Station agent, from stock of J. P. Norton, Broad Brook	4.95	4.5
	Baker Castor Oil Co., New York, N. Y.			
1535	10602	American Sumatra Tobacco Co., *Bloomfield*	4.62	4.5
1536	4510	American Sumatra Tobacco Co., Bloomfield	5.00	4.5
1565	83732	American Sumatra Tobacco Co., Bloomfield	5.17	4.5
1566	156521	American Sumatra Tobacco Co., Bloomfield	5.39	4.5
1691	28228	American Sumatra Tobacco Co., Bloomfield	5.04	4.5
1692	13331	American Sumatra Tobacco Co., Bloomfield	5.10	4.5
1693	17135	American Sumatra Tobacco Co., Bloomfield	5.29	4.5
1839		Station agent, from stock of Albert Wetstone, Ellington	4.94	4.5
	Berkshire Fertilizer Co., Bridgeport, Conn.			
1575		Station agent at factory	4.73	4.5
2092		Station agent, from stock of E. N. Austin, Suffield	4.39	4.5
	E. D. Chittenden Co., Bridgeport, Conn.			
2373		Station agent, from stock of Frank Bantle, Glastonbury	5.10	4.5
	Consolidated Rendering Co., Boston, Mass.			
1585		Station agent, from stock of L. T. Frisbie Co., New Haven	4.74	4.5

TABLE III. ANALYSES OF CASTOR POMACE—*Concluded.*

Station No.	Manufacturer or Jobber, Car No. or Mark.	Purchased, Sampled or Sent by	Per cent. Nitrogen. Found.	Per cent. Nitrogen. Guaranteed.
	A. W. Higgins, South Deerfield, Mass.			
335	N. Y. C. 243157	Spencer Bros., Suffield	4.79	4.52
60	N. Y. 215118	Spencer Bros., Inc., Suffield	5.06	4.52
37	....	Station agent, from stock of Spencer Bros., Inc., Suffield	5.17	4.52
	International Agricultural Corp., Woburn, Mass.			
17	....	Station agent, from stock of John Adams, East Granby	5.00	4.53
	Olds & Whipple, Hartford, Conn.			
80	....	Station agent at factory	4.70	5.00
97	....	L. Wetstone & Sons, Inc., Hartford	5.06	5.50
05	Thum. 50176	Huntting Bros., East Hartford	4.62	....
33	Thum.	H. E. Wells, Warehouse Point	5.47	4.94
34	Thum.	H. E. Wells, Warehouse Point	5.43	4.94
59	....	E. Handel, Glastonbury	6.14	....
	The Rogers & Hubbard Co., Portland, Conn.			
55	....	Station agent at factory	5.34	4.94
	Sanderson Fertilizer & Chemical Co., New Haven, Conn.			
66	....	Station agent, from stock of Geo. M. Hatch, New Milford	4.69	4.53
	Spencer Kellogg & Sons, Inc., Buffalo, N. Y.			
94	Kellogg Brand	John S. Leonard, Burnside	4.94	4.52
97	....	Station agent, from stock of Frank Manner, Burnside	5.41	4.52
	Wilcox Fertilizer Works, Mystic, Conn.			
47	....	Station agent, from stock of E. N. Austin, Suffield	4.92	4.52

COTTONSEED MEAL.

Fifty-three samples of cottonseed meal have been analyzed and are summarized in Table V. The grades represented are the 36, 41 and 43 per cent protein meals. Eleven samples were submitted with no statement of guaranty but analyses show them to be of the 41 or 43 per cent grade.

Of the fifty-three samples only three were deficient by more than 0.1 per cent of nitrogen; and in only two, 1109 *Dixie,* and **1831** *Bull,* would the deficiencies exceed $1.00 per ton reckoning nitrogen at 35 cents per pound. The average nitrogen found was 6.63 per cent and the average guaranty was 6.53 per cent. A similar computation last year showed an average of 0.15 per cent of nitrogen found over the average guaranteeed. Ninety-six per cent of samples substantially met or exceeded their guaranties.

The cost per pound of nitrogen in cottonseed meal has ranged from 38.1 cents in the 36 per cent protein grade to about 35.5 cents in the higher grades. The average for all samples is 35.9 cents as compared with 39.1 cents last year.

TABLE IV. SUMMARY OF DATA ON COTTONSEED MEAL.

Grade.	Number of Samples.	Average Nitrogen. %	Average Cost per Ton.	Average Cost of Nitrogen, Cents per Pound.
36 per cent (5.76 N)	7	5.87	44.00[1]	38.1
41 per cent (6.58 N)	24	6.65	47.24[2]	35.9
43 per cent (6.88 N)	11	6.87	45.53[3]	35.6
No guaranty	11	6.76	47.29[4]	35.2
Total and averages	53	6.63	47.78[5]	35.9

[1] Based on 4 quotations.
[2] " " 11 "
[3] " " 11 "
[4] " " 6 "
[5] " " 32 "

3517

TABLE V. ANALYSES OF COTTONSEED MEAL.

Station No.	Manufacturer or Jobber, Car No. or Mark.	Purchased, Sampled or Sent by	Per cent. Nitrogen. Found.	Per cent. Nitrogen. Guaranteed.
	Apothecaries Hall Co., Waterbury, Conn.			
2645	....	Station agent at the factory	6.67	6.58
	Ashcraft-Wilkinson Co., Atlanta, Ga.			
1211	87085, 262241, 33852, 23612, 97292, 265348, 896992, 14638 and 31842	American Sumatra Tobacco Co., Bloomfield	6.68	....
2458	Helmet	Station agent, from stock of E. J. Bantle, Glastonbury	6.50	6.56
1829	Helmet, N. Y. C. 50088	Spencer Bros., Inc., Suffield	6.69	6.56
1830	Helmet, B & A 32917	Spencer Bros., Inc., Suffield	6.65	6.56
1834	Monarch, So. 134029	Spencer Bros., Inc., Suffield	7.07	6.88
2451	Monarch	Station agent, from stock of Spencer Bros, Inc., Suffield	6.99	6.88
2452	Paramount	Station agent, from stock of Geo. S. Phelps & Co., Thompsonville	6.00	5.76
	S. P. Davis, Littlerock, Ark.			
1832	Steerboy	Spencer Bros., Inc., Suffield	6.92	6.88
2456	Steerboy	Station agent, from stock of Geo. T. Soule, New Milford	7.00	6.88
2457	Good Luck	Station agent, from stock of Amos D. Bridges Sons, Hazardville ..	6.64	6.50
	Humphreys-Godwin Co., Memphis, Tenn.			
1107	Dixie, 47145	L. B. Haas & Co., Hartford	6.62	6.58
1108	*Dixie, 80395*	*L. B. Haas & Co., Hartford*	*6.77*	*6.58*
1109	Dixie, 27787	L. B. Haas & Co., Hartford	6.30	6.58
1199	Bull	E. N. & C. C. Austin, Suffield ...	6.76	6.88
1212	S. A. L. 85210	Steane, Hartman & Co., Hartford	6.58	6.58
1213	M. P. 20636	Steane, Hartman & Co., Hartford	6.71	6.58
1214	S. P. 87711	Steane, Hartman & Co., Hartford	6.60	6.58
1215	Miss. Pac. 22431	Steane, Hartman & Co., Hartford	6.55	6.58
1216	N. Y., N. H. & H. 91693	Steane, Hartman & Co., Hartford	6.93	6.58
1217	M. P. 28373	Steane, Hartman & Co., Hartford	6.78	6.58
1218	S. S. W. 13406	Steane, Hartman & Co., Hartford	6.94	6.58
1219	S. L. & S. F. 30325	Steane, Hartman & Co., Hartford	6.53	6.58
1220	A. C. L. 37142	Steane, Hartman & Co., Hartford	6.57	6.58
1445	Dixie, 13027, 10619	American Sumatra Tobacco Co., Bloomfield	6.91	6.58
1446	Dixie, 36850, 45278, 39714, 19054, 95856, 76941, S116417	American Sumatra Tobacco Co., Bloomfield	6.81	6.58
1447	Dixie, 82527, 84734, 37842, 15272, 271004, 156387, 29750, 152365, 79712, 49180	American Sumatra Tobacco Co., Bloomfield	6.82	6.58

TABLE V. ANALYSES OF COTTONSEED MEAL—*Concluded.*

Station No.	Manufacturer or Jobber, Car No. or Mark.	Purchased, Sampled or Sent by	Per cent. Nitrogen. Found.	Per cent. Nitrogen. Guaranteed.
	Humphreys-Godwin Co., Memphis, Tenn.			
1472	28185, 12506, 32287, 97041, 49893, 29624, 31547, 128616, 43198	American Sumatra Tobacco Co., Bloomfield	6.86	....
1485	Dixie, 89628	Huntington Bros., Windsor	6.62	6.5[illegible]
1546	Bull	Station agent, from stock of E. N. Austin, Suffield	6.87	6.8[illegible]
1615	Dixie	Station agent, from stock of J. P. Norton, Broad Brook	6.78	6.5[illegible]
1647	Dixie, R. & N. 12505	L. B. Haas Co., Hartford	6.56	6.5[illegible]
1648	Dixie	L. B. Haas Co., Hartford	6.64	6.5[illegible]
1690	Bull, 9493, Atchinson, Topeka and Santa Fe	H. C. Nelson, West Suffield	6.83	6.8[illegible]
1788	Danish	C. Michel, West Suffield	6.01	5.7[illegible]
1798	Dixie, 31978	L. Wetstone & Sons, Inc., Hartford	6.82	6.5[illegible]
1799	Dixie, 40896	L. Wetstone & Sons, Inc., Hartford	6.81	6.5[illegible]
1828	Bull, L. & N. 98374	Spencer Bros., Inc., Suffield	6.79	6.8[illegible]
1831	Bull, S. S. & W. 30432	Spencer Bros., Inc., Suffield	6.60	6.8[illegible]
1833	Bull, M. O. P. 36420	Spencer Bros., Inc., Suffield	7.08	6.8[illegible]
1850	Dixie	Station agent, from stock of Glastonbury Farmers' Exchange, So. Glastonbury	6.58	6.5[illegible]
2016	Dixie, W. & W. 67902	Geo. S. Phelps & Co., Thompsonville	5.71	5.7[illegible]
2357	Bull, So. R. R. 164838	Spencer Bros., Inc., Suffield	6.83	6.8[illegible]
2358	Dixie, S. S. W. 24342	Spencer Bros., Inc., Suffield	6.47	6.5[illegible]
1486	Dixie, 79107	Huntington Bros., Windsor	6.78	6.5[illegible]
2359	Bull, So. R. R. 134354	Spencer Bros., Inc., Suffield	6.65	6.8[illegible]
2388	Danish, M. C. 99380	Spencer Bros., Inc., Suffield	5.75	5.7[illegible]
2389	Danish, C. Ga. 50124	Spencer Bros., Inc., Suffield	5.80	5.7[illegible]
2638	Danish, Cottonseed Feed	Station agent, from stock of A. E. Hall, Wallingford	5.75	5.7[illegible]
	International Agricultural Corp., Woburn, Mass.			
2462		Station agent, from stock of Howard Barriesford, West Suffield	6.81	6.5[illegible]
	Olds & Whipple, Hartford, Conn.			
1800	514937	Huntting Bros., East Hartford	6.55	....
1801	195396	Huntting Bros., East Hartford	6.62	....
	The Rogers & Hubbard Co., Portland, Conn.			
2096		Station agent at factory	5.95	5.7[illegible]

II. RAW MATERIALS CHIEFLY VALUABLE FOR PHOSPHORIC ACID.

PRECIPITATED BONE PHOSPHATE.

Commercial bone phosphate, obtained as a by-product in the manufacture of gelatin, consists largely of dicalcium phosphate, and the phosphorus is practically all in so-called "available" form.

Ten samples were analyzed, five of which were sampled by the station agent. Samples **2128** and **2521** did not meet the guaranty of 38 per cent total phosphoric acid although they averaged 36 per cent of available phosphoric acid. *So far as prices were quoted available phosphoric acid cost about 7 cents per pound.*

TABLE VI. ANALYSES OF PRECIPITATED BONE PHOSPHATE.

	Manufacturer or Wholesale Dealer.	Place of Sampling.	Phosphoric Acid. Citrate-insoluble.	Phosphoric Acid. Total.	"Available." Found.	"Available." Guaranteed.
	Sampled by Station:		%	%	%	
1	Apothecaries Hall Co., Waterbury	J. P. Norton, Broad Brook	1.15	38.70	37.55	36.00
7	Berkshire Fertilizer Co., Bridgeport	At factory	1.45	41.70	40.25	38.00
8	L. T. Frisbie Co., New Haven	At factory	1.15	36.48	35.33[1]	....
1	L. T. Frisbie Co., New Haven	At factory	0.65	37.30	36.65[1]	....
7	Olds & Whipple, Inc., Hartford	At factory	0.55	38.95	38.40	38.00
3	The Rogers & Hubbard Co., Portland	At factory	0.70	37.20	36.50	36.00
	Sampled by Purchaser:					
5	82715, 93520	American Sumatra Tobacco Co., Bloomfield	0.41	39.78	39.37	....
8	91048	American Sumatra Tobacco Co., Bloomfield	1.20	43.36	42.16	....
9	90373	American Sumatra Tobacco Co., Bloomfield	1.14	43.70	42.56	....
3	Olds & Whipple, Inc., Hartford	Huntting Bros., East Hartford	1.05	38.50	37.45	....

Guaranty, 38 per cent total.

DISSOLVED ROCK PHOSPHATE OR ACID PHOSPHATE.

Acid phosphate is made by treating raw rock phosphate with sulphuric acid which converts the phosphorus into available forms, chiefly, of the type which is soluble in water.

Twenty-four samples were analyzed all but three of which substantially equalled or exceeded their guaranties. Sample **1588** was about 0.5 per cent low; but two other samples of the same brand were well over the guaranty of 16 per cent. Sample **1453** was considerably under 16 per cent and no other sample of the same brand could be found. Sample **2736** was low but **1813**, of the same manufacture, substantially met the guaranty.

On the basis of eleven price quotations, available phosphoric acid in this raw material has cost about 7 cents per pound.

Analyses are given in Table VII.

TABLE VII. ANALYSES OF ACID PHOSPHATE.

Station No.	Manufacturer or Wholesale Dealer.	Dealer or Purchaser.	Phosphoric Acid. Citrate-insoluble.	Phosphoric Acid. Total.	Phosphoric Acid. "Available." Found.	Phosphoric Acid. "Available." Guaranteed.	Station No.
	Sampled by Station.		%	%	%		
1588	American Agricultural Chemical Co., New York	Geo. S. Phelps & Co., Thompsonville	0.45	15.93	15.48	16.00	1588
1895	American Agricultural Chemical Co., New York	Geo. S. Phelps & Co., Thompsonville	0.33	16.57	16.24	16.00	1895
2499	American Agricultural Chemical Co., New York	Lawton Miner Co., Collinsville	0.45	18.20	17.75	16.00	2499
1559	Apothecaries Hall Co., Waterbury	J. R. Reinhard, Cheshire	0.80	17.73	16.93	16.00	1559
2050	Armour Fertilizer Works, New York	Brower & Malone Co., Norwalk	0.18	16.34	16.16	16.00	2050
1518	Berkshire Fertilizer Co., Bridgeport	T. W. Ryan, Stratford	0.15	16.28	16.13	16.00	1518
1607	E. D. Chittenden Co., Bridgeport	Gunther Bros., Rockville	1.18	17.55	16.37	16.00	1607
1688	Everett B. Clark Seed Co., Milford	W. H. Burr, Southport	0.75	18.03	17.28	16.00	1688
1580	Consolidated Rendering Co., Boston	L T. Frisbie Co., New Haven	0.98	18.03	17.05	16.00	1580
1849	Consolidated Rendering Co., Boston	A. E. Shedd, Norwich	1.88	17.91	16.03	16.00	1849
1642	Eastern States Farmers' Exchange, Springfield, Mass.	Edgewood Farm, North Haven	0.80	16.98	16.18	16.00	1642
1904	Eastern States Farmers' Exchange, Springfield, Mass.	Henry Joy, Woodstock	0.78	16.86	16.08	16.00	1904
1899	International Agricultural Corp., Woburn, Mass.	E. D. Bartlett, Guilford	0.38	17.10	16.72	16.00	1899
2091	Nitrate Agencies Co., New York	E. N. Austin, Suffield	0.73	17.00	16.27	16.00	2091

TABLE VII. ANALYSES OF ACID PHOSPHATE—*Concluded.*

Station No.	Manufacturer or Wholesale Dealer.	Dealer or Purchaser.	Phosphoric Acid. Citrate-insoluble.	Phosphoric Acid. Total.	Phosphoric Acid. "Available." Found.	Phosphoric Acid. "Available." Guaranteed.	Station No.
	Sampled by Station:		%	%	%		
1682	Olds & Whipple, Inc., Hartford	Sampled at Factory	0.95	17.63	16.68	16.00	1682
1735	Piedmont Mt. Airy Guano Co., Baltimore, Md.	Seymour Grain & Coal Co., Seymour	1.10	17.20	16.10	16.00	1735
1550	The Rogers & Hubbard Co., Portland	Sampled at Factory	0.20	17.50	17.30	16.00	1550
2106	F. S. Royster Guano Co., Baltimore, Md.	Hitchcock Hardware Co., Watertown	1.90	17.90	16.00	16.00	2106
1740	Sanderson Fertilizer & Chemical Co., New Haven	Sampled at Factory	0.28	17.85	17.57	16.00	1740
1453	I. P. Thomas & Son Co., Philadelphia, Pa.	Highwood Vegetable Growers' Association Highwood	1.75	16.63	14.88	16.00	1453
2163	Triton Oil & Fertilizer Co., New York	Paty Schwartz Co., New London	0.45	17.45	17.00	16.00	2163
1807	United States Guano Co., Baltimore, Md.	Knowles, Lombard Co., Guilford	0.83	17.45	16.62	16.00	1807
1813	Wilcox Fertilizer Works, Mystic	Jordan Hardware Co., Willimantic	0.13	17.00	16.87	17.00	1813
2736	Wilcox Fertilizer Works, Mystic	Manufacturer's sample	0.08	16.26	16.18	17.00	2736

III. RAW MATERIALS CONTAINING POTASH.

CARBONATE OF POTASH.

Pure carbonate of potash contains 68.2 per cent of actual potash (K_2O), but commercial grades will usually contain from 60 to 65 per cent.

All of the samples examined, six in number, were submitted by the purchaser and the only guaranty given was 96 per cent carbonate of potash which is equivalent to about 65.5 per cent of K_2O. The samples examined ranged from 58.5 to 67.6 per cent. Another sample, **1569**, was submitted by the American Sumatra Tobacco Co. as carbonate of potash, but there was apparently an error in sampling. The material contained only 24 per cent of potash with much phosphoric acid and was evidently a mixture of carbonate of potasb and precipitated bone.

Analyses are given in Table VIII.

MURIATE OF POTASH.

The grade of this salt chiefly used for fertilizer is about 80 per cent pure and is generally guaranteed to contain from 48 to 50 per cent of actual potash (K_2O).

Fourteen samples were drawn by the station agent and one was submitted by a purchaser. Three samples, **1584**, **1687** and **1809** failed to equal their guaranties but second samples of two of these, **1846** and **2122**, were not found deficient. No second sample of **1687** was found.

On the basis of prices quoted potash from this source cost 5 cents per pound.

Analyses are given in Table VIII.

HIGH GRADE SULPHATE OF POTASH.

This material is about 90 per cent pure sulphate of potash which is equivalent to about 48 per cent of actual potash (K_2O).

Eight samples were drawn by the station agent and six were examined for purchasers. All substantially equalled or exceeded their guaranties.

Potash from this source cost, at the prices quoted, about 6 cents per pound.

Analyses are given in Table VIII.

DOUBLE SULPHATE OF POTASH AND MAGNESIA.
(Double Manure Salts.)

Only three samples were analyzed this season. All satisfied the requirement of 26 per cent of potash and contained from 10 to 14.5 per cent of magnesia.

Analyses are given in Table VIII.

KAINIT.

The one sample of kainit examined fully satisfied the guaranty. The analysis is given in Table VIII.

TABLE VIII. ANALYSES OF POTASH SALTS.

Station No.	Manufacturer or Wholesale Dealer.	Dealer or Purchaser.	Potash. Found.	Potash. Guaranteed.	Station No.
	Carbonate of Potash. *Sampled by Purchaser:*		%	%	
1405	A. Klipstein, New York City	American Sumatra Tobacco Co., Bloomfield	64.92	65.40	1405
1406	" " " "	" " " " "	58.51	65.40	1406
1568	" " " "	" " " " "	64.51	65.40	1568
1570	" " " "	" " " " "	64.42	65.40	1570
1571	" " " "	" " " " "	67.64	65.40	1571
1572	" " " "	" " " " "	67.06	65.40	1572
	Muriate of Potash. *Sampled by Station:*				
1591	Apothecaries Hall Co., Waterbury	Sampled at Factory	51.72	50.00	1591
2053	Armour Fertilizer Works, New York	F. A. Bartlett Tree Expert Co., Stamford	48.38	48.00	2053
1519	Berkshire Fertilizer Co., Bridgeport	T. W. Ryan, Stratford	50.34	50.00	1519
1608	E. D. Chittenden Co., Bridgeport	Gunther Bros., Rockville	52.22	48.00	1608
1846	Consolidated Rendering Co., Boston	A. E. Shedd, Norwich	50.39	50.00	1846
1584	Consolidated Rendering Co., Boston	L. T. Frisbie Co., New Haven	49.20	50.00	1584
1687	Everett B. Clark Seed Co., Milford	W. H. Burr, Southport	47.99	50.00	1687
2407	Eastern States Farmers' Exchange, Springfield, Mass.	B. W. Bishop, Guilford	50.55	50.00	2407
1920	International Agricultural Corp., Woburn, Mass.	E. D. Bartlett, Guilford	51.67	48.00	1920

TABLE VIII. ANALYSES OF POTASH SALTS—Continued.

Station No.	Manufacturer or Wholesale Dealer.	Dealer or Purchaser.	Potash. Found.	Potash. Guaranteed.	Station No.
	Muriate of Potash—*Concluded.*				
	Sampled by Station:		%	%	
2089	Nitrate Agencies Co., New York	E. N. Austin, Suffield	48.99	48.00	2089
2150	F. S. Royster Guano Co., Baltimore, Md.	Hitchcock Hardware Co., Watertown	49.61	48.00	2150
1454	I. P. Thomas & Son Co., Philadelphia, Pa.	Highwood Vegetable Growers' Association, Highwood	50.85	50.00	1454
1809	United States Guano Co., Baltimore, Md.	Knowles, Lombard Co., Guilford	45.00[1]	50.00	1809
2122	United States Guano Co., Baltimore, Md.	Knowles, Lombard Co., Guilford	50.27	50.00	2122
	Sampled by Purchaser:				
2060	Apothecaries Hall Co., Waterbury	Francis M. Coe, *Litchfield*	51.79	50.00	2060
	Sulphate of Potash.				
	Sampled by Station:				
1587	American Agricultural Chemical Co., New York	Geo. S. Phelps & Co., Thompsonville	47.92	48.00	1587
1610	Apothecaries Hall Co., Waterbury	J. P. Norton, Broad Brook	48.53	48.00	1610
1578	Berkshire Fertilizer Co., Bridgeport	Sampled at Factory	50.15	48.00	1578
1861	E. D. Chittenden Co., Bridgeport	E. J. Bantle, Glastonbury	48.77	48.00	1861
1581	Consolidated Rendering Co., Boston	L. T. Frisbie Co., New Haven	50.01	48.00	1581
2438	International Agricultural Corp., Woburn, Mass.	James T. Caffrey, Cromwell	50.01	50.00	2438
2433	Olds & Whipple, Inc., Hartford	Sampled at Factory	50.05	48.65	2433
1676	The Rogers & Hubbard Co., Portland	Sampled at Factory	50.39	48.00	1676

[1] Contains considerable sulphate.

TABLE VIII. ANALYSES OF POTASH SALTS—*Concluded.*

Station No.	Manufacturer or Wholesale Dealer.	Dealer or Purchaser.	Potash. Found.	Potash. Guaranteed.	Station No.
	Sulphate of Potash—*Concluded.* *Sampled by Purchaser:*		%	%	
2154	Berkshire Fertilizer Co., Bridgeport	Martin Noone, Suffield	49.12	48.00	2154
1450	Olds & Whipple, Inc., Hartford	American Sumatra Tobacco Co., Bloomfield	50.40	48.65	1450
1451	" " " "	" " " " "	50.04	48.65	1451
1823	" " " "	" " " " "	48.72	48.65	1823
1484	" " " "	Huntington Bros., Windsor	49.61	48.65	1484
1802	" " " "	Huntting Bros., East Hartford	49.53	48.00	1802
	Double Manure Salts. *Sampled by Station:*				
2320	Apothecaries Hall Co., Waterbury	Sampled at Factory	28.19[1]	26.00	2320
1579	Berkshire Fertilizer Works, Bridgeport	Sampled at Factory	28.46[2]	26.00	1579
1678	Olds & Whipple, Inc., Hartford	Sampled at Factory	26.38[3]	26.00	1678
	Kainit. *Sampled by Station:*				
1701	Eastern States Farmers' Exchange, Springfield, Mass.	Edgewood Farm, North Haven	13.82	12.40	1701

[1] Magnesia 9.97.
[2] Magnesia 12.25.
[3] Magnesia 14.50, chlorine 1.50.

IV. RAW MATERIALS CONTAINING NITROGEN AND POTASH.

Only two samples of this group of materials have been examined, both taken by the station agent.

1592. Nitrate of Soda and Potash. Apothecaries Hall Co., Waterbury. Sampled at the factory.

2088. Naco Brand, Nitrapo. Nitrate Agencies Co., New York. Sampled from stock of E. N. Austin, Suffield.

Sample **2088** was deficient in both essential ingredients.

TABLE IX. ANALYSES OF NITRATE OF SODA AND POTASH.

Station No.	1592	2088
Nitrogen:		
found	14.84	14.12
guaranteed	14.80	15.00
Equivalent to ammonia:		
found	18.04	17.17
guaranteed	18.00	18.25
Potash:		
found	13.48	14.77
guaranteed	12.00	15.00

V. RAW MATERIALS CONTAINING NITROGEN AND PHOSPHORIC ACID.

DRY GROUND FISH.

Twenty-six samples of dry ground fish were analyzed, ten of which were official samples drawn by the station agent. All of the official samples equalled or exceeded their guaranties except **1554** which was 0.32 per cent low in nitrogen and **2090** which was deficient in phosphoric acid.

In the official samples the average nitrogen found was 8.80 per cent and the average phosphoric acid 7.59 per cent. *On the basis of the prices quoted to our agent, allowing 4 cents per pound for phosphoric acid, nitrogen in this material cost about 37.7 cents per pound. A similar calculation last year showed the cost per pound to be 37.9 cents.*

Analyses are given in Table X.

TABLE X. ANALYSES OF DRY GROUND FISH.

Station No.	Manufacturer or Wholesale Dealer.	Dealer or Purchaser.	Nitrogen. Total found.	Nitrogen. Total guaranteed.	Ammonia equivalent to total nitrogen.	Phosphoric Acid. Total found.	Phosphoric Acid. Total guaranteed.	Station No.
			%	%	%	%	%	
	Sampled by Station:							
1896	American Agricultural Chemical Co., New York	Geo. S. Phelps & Co., Thompsonville	8.50	8.23	10.34	7.85	6.00	1896
1614	Apothecaries Hall Co., Waterbury	J. P. Norton, Broad Brook	8.61	8.20	10.47	6.30	5.00	1614
1522	Berkshire Fertilizer Co., Bridgeport	T. W. Ryan, Stratford	8.25	8.22	10.03	7.33	....	1522
2367	E. D. Chittenden Co., Bridgeport	E. J. Bantle, Glastonbury	8.82	8.00	10.72	7.05	6.00	2367
2408	Consolidated Rendering Co., Boston	W. A. Forbes, Silver Lane	8.32	8.22	10.12	10.15	6.40	2408
2090	Nitrate Agencies Co., New York	E. N. Austin, Suffield	9.73	9.05	11.83	5.73	7.00	2090
1679	Olds & Whipple, Inc., Hartford	Sampled at Factory	8.96	8.23	10.89	7.48	5.00	1679
1554	The Rogers & Hubbard Co., Portland	Sampled at Factory	9.13	9.45	11.10	8.63	....	1554
1916	Sanderson Fertilizer & Chemical Co., New Haven	Phelps Coal Co., Glastonbury	8.56	8.23	10.41	7.53	6.00	1916
2188	Wilcox Fertilizer Works, Mystic	Sampled at Factory	9.09	9.04	11.05	7.88	6.00	2188
	Sampled by Purchaser:							
943	Berkshire Fertilizer Co., Bridgeport	American Sumatra Tobacco Co., Bloomfield	8.52	....	10.36	8.41	....	943
944	" " " "	" "	7.81	....	9.50	8.62	....	944
957	" " " "	" "	8.31	....	10.10	7.94	....	957
958	" " " "	" "	8.15	....	9.91	8.10	....	958
959	" " " "	" "	8.20	....	9.97	8.33	....	959
1028	" " " "	" "	8.44	....	10.26	8.01	....	1028
1030	" " " "	" "	8.46	....	10.29	8.51	....	1030
1031	" " " "	" "	8.17	....	9.93	8.02	....	1031

TABLE X. ANALYSES OF DRY GROUND FISH—*Concluded.*

Station No	Manufacturer or Wholesale Dealer.	Dealer or Purchaser.	Nitrogen. Total found.	Nitrogen. Total guaranteed.	Ammonia equivalent to total nitrogen.	Phosphoric Acid. Total found.	Phosphoric Acid. Total guaranteed.	Station No.
	Sampled by Purchaser:		%	%	%	%	%	
1032	Berkshire Fertilizer Co., Bridgeport ..	American Sumatra Tobacco Co., Bloomfield	8.29	....	10.08	8.12	....	1032
1033	" " " "	" "	8.11	....	9.86	8.30	....	1033
1034	" " " "	" "	7.97	....	9.69	8.38	....	1034
1035	" " " "	" "	8.23	....	10.01	8.00	....	1035
1036	" " " "	" "	8.12	....	9.87	8.15	....	1036
2153	" " " "	E. N. Austin, Suffield	8.38	8.23	10.19	6.85	6.00	2153
1804	Olds & Whipple, Inc., Hartford	Huntting Bros., East Hartford ..	8.48	....	10.31	7.20	....	1804
1822	Olds & Whipple, Inc., Hartford	American Sumatra Tobacco Co., Bloomfield	8.51	....	10.35	6.68	....	1822

TANKAGE.

This material varies considerably in composition depending upon the relative amounts of bone and meat which it contains. In general products containing less than 5 per cent of nitrogen and over 15 per cent of phosphoric acid show a preponderance of bone, while those showing over 5 per cent of nitrogen and less than 15 per cent of phosphoric acid show substantial quantities of meat.

Sixteen samples were analyzed, thirteen of which were officially drawn. . Of the official samples four, **1560**, **1604**, **2522**, and **1860** averaged 4.09 per cent of nitrogen and 21.85 per cent of phosphoric acid and are, therefore, bone and meat tankages. The remainder were meat tankages and averaged 7.55 per cent of nitrogen and 9.04 per cent of phosphoric acid.

Prices vary greatly for this raw material depending upon whether it is essentially nitrogenous or phosphatic in type. Thus the approximate valuations of the two samples containing the extremes of nitrogen, assuming values of 30 cents per pound for nitrogen and 4 cents for phosphoric acid, range from $39.00 to $68.00 per ton.

Analyses are given in Table XI.

Station No	Manufacturer.	Dealer or Purchaser.	Nitrogen. Total found.	Nitrogen. Total guaranteed.	Ammonia equivalent to total nitrogen	Phosphoric Acid. Found.	Phosphoric Acid. Guaranteed.	Mechanical Analysis. *Finer than* 1-50 inch.	Mechanical Analysis. Coarser than 1-50 inch.	Station No.
	Sampled by Station:		%	%	%	%	%	%	%	
1560	Apothecaries Hall Co., Waterbury	J. R. Reinhard, West Cheshire ..	4.02	3.29	4.89	24.70	20.00	50.0	50.0	1560
1590	Apothecaries Hall Co., Waterbury	Sampled at Factory	7.76	7.40	9.43	3.68	3.00	64.0	36.0	1590
2325	Armour Fertilizer Works, New York	C. A. Templeton, Waterbury	6.96	7.40	8.46	10.99	6.87	50.0	50.0	2325
1520	Berkshire Fertilizer Co., Bridgeport	T. W. Ryan, Stratford	6.92	7.40	8.41	11.90	6.86	50.0	50.0	1520
2134	Everett B. Clark Seed Co., Milford	Geo. S. Jennings, Southport	7.35	7.40	8.94	4.25	13.73	41.0	59.0	2134
1686	Everett B. Clark Seed Co., Milford	W. H. Burr, Southport	5.23	4.93	6.36	13.60	13.73	44.0	56.0	1686
1604	Conn. Fat Rendering and Fertilizer Corp., New Haven	Sampled at Factory	3.82	3.29	4.64	21.85	25.00	50.0	50.0	1604
2522	Conn. Fat Rendering and Fertilizer Corp., New Haven	Sampled at Factory	3.52	3.29	4.28	22.76	25.00	50.0	50.0	2522
1860	Consolidated Rendering Co., Boston	Burr Nurseries, Manchester	4.98	4.92	5.96	18.10	14.00	39.0	61.0	1860
1616	L. T. Frisbie Co., New Haven	Sampled at Factory	10.41	9.87	12.66	6.30	4.57	24.0	76.0	1616
1900	International Agricultural Corp., Woburn, Mass.	E. D. Bartlett, Guilford	5.33	4.93	6.48	13.95	11.00	43.0	57.0	1900
1455	I. P. Thomas & Son Co., Philadelphia, Pa.	Highwood Vegetable Growers' Asociation, Highwood	10.33[1]	....	12.56	5.12	....	41.0	59.0	1455
1818	Worcester Rendering Co., Auburn, Mass.	A. E. Shedd, Norwich	7.64	5.74	9.29	11.60	10.00	37.0	63.0	1818
	Sampled by Purchaser:									
1118	Conn. Fat Rendering and Fertilizer Corp., New Haven	Sent from Factory	4.87	....	5.92	....	....	....	....	1118
1892	Consolidated Rendering Co., Boston	C. R. Burr & Co., Manchester ...	5.27	4.94	6.41	17.98	14.00	36.0	64.0	1892
2032	Consolidated Rendering Co., Boston	The Lyman Farm, Middlefield ..	4.88	...	5.93	14.93	....	33.0	67.0	2032

[1] Sold on unit of ammonia basis.

GROUND BONE.

Twenty-six samples have been examined, all but two of which were official samples.

Sample **1593** was deficient in nitrogen (0.2 per cent), and **2496** was considerably below guaranty in phosphoric acid. In the other samples guaranties were substantially met and in most cases there were liberal overages in both of the elements of plant food.

TABLE XII. ANALYSES OF GROUND BONE.

Station No.	Manufacturer.	Dealer or Purchaser.	Nitrogen. Found.	Nitrogen. Guaranteed.	Ammonia equivalent to total nitrogen.	Phosphoric Acid. Found.	Phosphoric Acid. Guaranteed.	Mechanical Analysis. Finer than 1-50 inch.	Mechanical Analysis. Coarser than 1-50 inch.	Station No.
	Sampled by Station:		%	%	%	%	%	%	%	
1586	American Agricultural Chemical Co., New York	F. S. Bidwell Co., Windsor Locks	2.51	2.47	3.05	26.60	22.88	61.0	39.0	1586
1557	Apothecaries Hall Co., Waterbury	R. W. Hine, Cheshire	3.56	3.29	4.33	23.20	20.00	56.0	44.0	1557
2049	Armour Fertilizer Works, New York	Harrison & Gould, Milford	2.43	2.47	2.95	25.50	22.00	55.0	45.0	2049
1576	Berkshire Fertilizer Co., Bridgeport	Sampled at Factory	2.66	2.47	3.23	26.35	20.00	56.0	44.0	1576
2133	Everett B. Clark Seed Co., Milford	Geo. S. Jennings, Southport	3.18	2.47	3.87	22.60	22.88	48.0	52.0	2133
1863	E. D. Chittenden Co., Bridgeport	E. J. Bantle, Glastonbury	2.54	2.47	3.09	26.80	22.00	52.0	48.0	1863
1593	Consolidated Rendering Co., Boston	*Rockville Milling Co., Rockville*	1.85	2.05	2.25	27.30	25.18	39.0	61.0	1593
1894	Consolidated Rendering Co., Boston	Willimantic Grain Co., Willimantic	3.18	2.46	3.87	23.60	22.90	42.0	58.0	1894
2406	Eastern States Farmers' Exchange, Springfield, Mass.	Newtown Grain & Coal Co., Newtown	2.61	2.47	3.17	23.50	22.88	47.5	52.5	2406
1606	L. T. Frisbie Co., New Haven	Sampled at Factory	4.31	3.28	5.24	21.65	22.00	34.0	66.0	1606
1605	L. T. Frisbie Co., New Haven	*Lightbourn & Pond Co., New Haven*	3.24	2.46	3.94	24.75	22.90	45.0	55.0	1605
1898	International Agricultural Corp., Woburn, Mass.	Jacob Bantley, Glastonbury	2.82	2.50	3.43	26.30	22.00	63.0	37.0	1898
1915	New England By-Products Corp., Lawrence, Mass.	Peterson Hendee Co., Derby	3.86	3.75	4.69	26.45	25.00	61.0	39.0	1915
1683	Olds & Whipple, Inc., Hartford	F. T. Blish Hardware, So. Manchester	2.48	2.50	3.02	27.05	22.00	53.0	47.0	1683
1525	Piedmont-Mt. Airy Guano Co., Baltimore, Md.	Lightbourn & Pond Co., New Haven	4.03	2.47	4.90	15.00	22.90	45.0	55.0	1525

TABLE XII. ANALYSES OF GROUND BONE—*Concluded.*

Station No.	Manufacturer.	Dealer or Purchaser.	Nitrogen. Found.	Nitrogen. Guaranteed.	Ammonia equivalent to total nitrogen.	Phosphoric Acid. Found.	Phosphoric Acid. Guaranteed.	Mechanical Analysis. Finer than 1-50 inch.	Mechanical Analysis. Coarser than 1-50 inch.	Station No.
	Sampled by Station:		%	%	%	%	%	%	%	
2102	The Rogers & Hubbard Co., Portland	Frank E. Beach, Branford	3.66	3.29	4.45	21.55	20.50	42.0	58.0	2102
1621	The Rogers & Hubbard Co., Portland	Cadwell & Jones, Hartford	3.71	3.82	4.51	25.00	24.70	52.0	48.0	1621
2520	The Rogers & Hubbard Co., Portland	Sampled at Factory	3.76	3.82	4.57	26.30	24.70	80.0	20.0	2520
1750	F. S. Royster Guano Co., Baltimore, Md.	W. S. Brown, Trumbull	3.16	2.47	3.84	26.85	22.90	66.0	34.0	1750
1745	Sanderson Fertilizer & Chemical Co., New Haven	G. W. Thorpe, West Cheshire	2.73	2.47	3.32	25.35	22.88	59.0	41.0	1745
1909	M. L. Shoemaker & Co., Philadelphia, Pa.	Olds & Whipple, Inc., Hartford	6.39	4.51	7.77	20.45	20.00	37.0	63.0	1909
1458	I. P. Thomas & Son, Philadelphia, Pa.	Highwood Vegetable Growers' Asociation, Highwood	2.78	2.45	3.38	24.86	23.00	50.0	50.0	1458
2496	U. S. Guano Co., Baltimore, Md.	Rackliffe Bros. Co., New Britain	3.13	2.46	3.81	21.77	23.00	52.0	48.0	2496
2184	Wilcox Fertilizer Works, Mystic	Jordan Hardware Co., Willimantic	2.54	2.46	3.09	26.60	22.00	60.0	40.0	2184
	Sampled by Purchaser:									
1407	....	American Sumatra Tobacco Co., Bloomfield	2.70	....	3.28	26.02	....	46.0	54.0	1407
1819	Sanderson Fertilizer & Chemical Co. New Haven	American Sumatra Tobacco Co., Bloomfield	2.85	....	3.46	25.70	....	57.0	43.0	1819

MIXED FERTILIZERS.

MIXTURES CONTAINING ONLY NITROGEN AND PHOSPHORIC ACID.

Only four samples of this group of fertilizers were examined.

1731. *Top Dressing for Grass.* Olds and Whipple, Inc., Hartford. Sampled by the station agent from stock of F. T. Blish Hardware Co., So. Manchester.

2439. High Grade Tobacco Starter. Olds and Whipple, Inc., Hartford. Sampled by station agent at the factory.

2644. Ammo-Phos. American Cyanamid Co., New York. Sampled by station agent from stock of Olds and Whipple, Inc., Hartford.

1746. Swift Sure Tobacco Starter. M. L. Shoemaker and Co., Philadelphia. Sampled by station agent from stock of F. S. Bidwell & Co., Windsor Locks.

Analyses are as follows:

Station No.	1731	2439	2644	1746
	%	%	%	%
Nitrogen, found	6.43	8.61	15.80	3.27
guaranteed	5.75	8.23	16.45	3.25
Ammonia equivalent to nitrogen	7.82	10.47	19.21	3.98
Phosphoric acid, total	4.95	5.45	21.55	13.70
available, found	4.35	4.55	20.82	11.55
guaranteed	4.00	3.00	20.00	10.00

In all these samples the quality of the insoluble organic nitrogen was satisfactory as judged by the usual methods.

MIXTURES CONTAINING AMMONIA, PHOSPHORIC ACID AND POTASH.

In Table XIII are given the analyses of two hundred and fifty-five samples of complete fertilizers, sampled by the station agent, and of fourteen sampled by purchasers, making two hundred and sixty-nine in all.

The figures in the column headed "grade" represent the guaranteed percentages of ammonia, available phosphoric acid and potash in the order named. Thus, for example, **4-8-4** means that the brand is guaranteed to contain at least 4 per cent of ammonia, 8 per cent of available phosphoric acid, and 4 per cent of potash. The figures in the analyses which correspond to these values are given in bold face type so that the comparison between the plant food guaranteed and that found on analysis can be readily made.

The essential facts concerning the inspection may be summarized as follows:

Total number of official samples		255
Samples considerably deficient:		
Deficient in one item	74	
" in two items	10	
" in three items	0	
Total		84
Total deficiencies		94
Total guaranties made, (total samples x 3)		765
Total number of samples showing deficiencies in money value of $1.00 per ton or more		13

This summary shows that about 1/3 (32.9 per cent), of the total number of samples examined have failed to satisfy their guaranties in all items of plant food. Seventy-four samples were deficient in one ingredient only; ten were deficient in two ingredients; and none were deficient in all ingredients. Amounts of plant food have substantially equalled or exceeded guaranties in 87.7 per cent of the total number of guaranties made; and, when overages are balanced against shortages, samples have shown commercial values[1] substantially conforming to those required by the guaranties in about 95 per cent of the total number of samples examined.

Concerning Guaranties.

A study of the distribution of deficiencies in plant food shows that those in ammonia, phosphoric acid, and potash are about equally distributed, there being 35, 28, and 31 in the order named. While in the majority of cases analyses show that guaranties are insured by liberal overruns, yet too often there is evidence of insufficient allowance for reasonable margins of safety.

Analyses as soon as made are reported to the manufacturer, to the dealer and to the purchaser. In case of considerable deficiencies, second samples are analyzed if such have been taken or can be obtained. Thus questions arising concerning analysis or sampling may be investigated and adjusted if possible.

The following comments may be offered with reference to the samples cited.

2312. A. A. C. Co's National Market Garden Fertilizer. This was guaranteed 4.00 per cent potash and 3.66 per cent was found. The manufacturer obtained 3.76 per cent on a duplicate portion of our sample.

2327. A. A. C. Co's Quinnipiac Market Garden Manure. Guaranteed 7 per cent potash. We reported 6.65 per cent whereas the manufacturer found 6.79 per cent in a duplicate portion of our sample.

1773. Armour's Big Crop Fertilizer **5-8-7**. Our report showed this sample to be low in ammonia and in available phos-

[1] Ammonia has been reckoned at 20.6¢ per pound; and available phosphoric acid and potash at 4¢ per pound each.

phoric acid. Checks by the manufacturer substantially agreed with our figures.

2099. Royster's Bully Guano. Guaranteed 5 per cent potash. Our report showed 4.66 potash and the manufacturer's check showed 4.88 per cent. Rechecks by us showed 4.53 and 4.51 per cent.

1857. Bowker's Stockbridge Truck Manure. Analysis showed this to be a **4-8-6** instead of a **4-8-7** brand as tagged. The manufacturer questioned the sampling but no error was found in the inspection report. A second sample of the same brand substantially comformed to guaranty in two ingredients but was deficient in potash.

Deficiencies in Money Value.

Thirteen samples show shortages in money value in excess of $1.00 per ton, such shortages being duly balanced against any overruns shown, and reckoning ammonia, available phosphoric acid and potash at the values previously cited (p. 44). In all these cases second samples were secured if possible and analyzed if obtained. A summary of deficient brands is given in Table XIV.

Table XIV. Brands Showing Commercial Deficiencies.

No.	Brand.	Approximate deficiency in money value per ton.
2495, 1773	Armour's Big Crop 5-8-7	$1.20[1]
1857	*Bowker's Stockbridge Truck Manure*	*1.16*[2]
2371, 2526	Chittenden's Potato Special 6% Potash	2.17[1]
2411	Chittenden's Top Dresser 4% Potash	3.03
2416	Davey Tree Food	1.09
1903	*Eastern States 5-8-7*	*3.24*[2]
2442	International Tobacco Producer	1.77[2]
2083	Lowell Top Dressing 7-5-2	1.10[2]
2511	*Piedmont Mt. Airy Harvest Brand 8-6-6*	*3.30*[3]
2149	Royster's Valley Tobacco Formula	1.59
2497	U. S. Guano Co. Standard U. S. Farmer's Formula	3.26

[1] Based on average of two samples
[2] Second sample not deficient. Average of two not deficient.
[3] Second sample not deficient.

Attention has already been directed to the fact that these samples showing considerable commercial deficiencies constitute but 5 per cent of the total number of samples examined. If these data are incorporated with similar data for the previous four years we shall gain some conception of what purchasers of mixed fertilizers have received for their money during the five year period. It appears from Table XV that in this interval 1276 official samples have been analyzed, and that 1155 (90.5 per cent) samples have substantially met or have exceeded the com-

mercial valuations represented by their guaranties. A few manufacturers, of whose goods less than 10 samples have been examined in this stated period, are not included in the summary. The products of a given manufacturer are more adequately judged on the basis of a period of years; but in order to recognize improvement, if made, the comparative figures for the past year are given separately.

TABLE XV. COMMERCIAL DEFICIENCIES 1921-1925 INCLUSIVE.

Manufacturer.	Total number of samples.	Number equaling or exceeding guaranties in money value.	Per cent in 5-yr. period.	Per cent in 1925.
American Agricultural Chemical Co.	218	207	95	100
Apothecaries Hall Co.	39	39	100	100
Armour Fertilizer Works	55	39	71	75
Atlantic Packing Co.	37	33	89	100
Berkshire Fertilizer Co.	40	40	100	100
Boardman, F. E.	10	10	100	100
Bowker Fertilizer Co.	71	63	89	93
Bridges, A. D. & Sons	10	10	100	100
Chittenden, E. D. Co.	34	30	88	63
Clark, E. B. Seed Co.	23	21	91	100
Coe-Mortimer Co., The	30	27	90	...
Eastern States Farmers' Exchange	49	41	84	90
Essex Fertilizer Co.	35	34	97	100
Frisbie, L. T. Co.	57	47	83	100
International Agricultural Corp.	46	41	89	92
Lowell Fertilizer Co.	51	43	84	89
Mapes Fertilizer and Peruvian Guano Co.	65	64	99	100
New England Fertilizer	42	39	93	100
Nitrate Agencies Co.	14	11	79	...
Olds & Whipple, Inc.	29	29	100	100
Parmenter & Polsey Fertilizer Co.	19	18	95	100
Piedmont Mt. Airy Guano Co.	19	11	58	90
Rogers & Hubbard Co., The	67	65	97	100
Royster, F. S. Guano Co.	37	27	73	86
Sanderson Fertilizer and Chemical Co.	41	39	95	100
Shoemaker, M. L. & Co.	13	13	100	100
Springfield Rendering	22	20	91	100
Virginia-Carolina Chemical Co.	45	42	93	100
Wilcox Fertilizer Works	41	38	93	100
Worcester Rendering Co.	17	14	82	100
Total	1,276	1,155	91	95

THE "NEW ENGLAND STANDARD NINE."

Of the two hundred and fifty-five official samples of complete fertilizers, less than one-half (113) have fallen in the "Standard Nine" group; but if grades closely corresponding thereto are

included the number is somewhat over one-half (133). Last year it was found that about 36 per cent of the samples examined fell exactly in these nine grades whereas this year the proportion is 44 per cent. As was the case last year, the largest number of samples have fallen in the grades **4-8-4**, **5-4-5**, and **5-8-7**.

In the following summary the "Standard Nine" grades are indicated in full face type.

Grade.	No. of Samples.
0-12-6	0
2-12-4	2
3-10-3	5
3-10-4	6
3-10-6	0
4-7-5	1
4-8-4	32
4-8-5	1
4-8-6	10
4-8-7	10
5-4-4	0
5-4-5	29
5-8-6	3
5-8-7	28
8-6-6	6
Total	133

Quality of the Insoluble Organic Nitrogen.

The accepted methods of evaluating the insoluble organic nitrogen in fertilizers determines the proportion which is "active." Thus activity values of under 50 per cent by the so-called alkaline method and 80 per cent by the so-called neutral method are taken as indicating inferior forms of nitrogenous materials. In several brands examined during the past season values somewhat less than these just given have been found; but in all these cases the percentages of water-soluble nitrogen plus the active insoluble nitrogen exceeded or closely approximated the nitrogen guaranties and the question of quality was not raised.

TABLE XIII. ANALYSES OF MIXED FERTILIZERS

Station No.	Manufacturer and Brand.	Grade.	Place of Sampling.
	Sampled by Station: **American Agricultural Chemical Co., New York.**		
2020	Complete Potato Mixture	3-8-4	Glenbrook
2029	Crescent Complete Manure	2-8-3	Bloomfield
2028	Double A Tobacco Fertilizer	5-4-5	Bloomfield
2024	Farm Favorite	2-10-2	Farmington
2027	Fish and Potash	3-10-3	Granby
2022	Grass and Lawn Top Dressing	6-6-4	Warehouse Point
2025	7% Potash Fertilizer	4-8-7	New Britain
2018	Universal Phosphate	1-8-2	North Haven
2331	Bowker's Lawn and Garden Dressing	3-9-2	Hartford
2306	Bradley's Complete Manure for Potatoes and Vegetables	4-8-7	Bethel
2311	Bradley's Complete Tobacco Manure	5-4-5	Glastonbury
2021	Bradley's Corn Phosphate	2-10-2	Bethel
2019	Bradley's New Method Fertilizer	1-8-2	Meriden
2315	Bradley's Northland Potato Grower	4-8-4	Colchester
2026	Bradley's Potato Fertilizer	2-8-3	Canaan
2304	Bradley's Potato Manure	3-8-4	Meriden
1624	Bradley's XL Superphosphate of Lime	3-10-4	Thompsonville
2500	Bradley's XL Superphosphate of Lime	3-10-4	Simsbury
2314	National Complete Tobacco Fertilizer	5-4-5	South Windsor
2307	National Eureka Potato Fertilizer	4-8-4	Danbury
2312	National Market Garden Fertilizer	3-8-4	Wallingford
2308	National Potato and Corn Phosphate	2-8-3	Danbury
2310	National Premier Truck Manure	4-8-7	Warehouse Point
2309	National White Ash Tobacco Grower	7-3-7	Warehouse Point
2313	National XXX Fish and Potash	3-10-3	Wallingford
2321	Quinnipiac Corn Manure	2-10-2	South Norwalk
2327	Quinnipiac Market Garden Manure	4-8-7	New London
2326	Quinnipiac Potato Phosphate	2-8-3	New London
2329	Quinnipiac Prime Tobacco Manure	7-3-7	Manchester
2330	Quinnipiac Seed Leaf Tobacco Manure	5-4-5	Gaylordsville
	Apothecaries Hall Co., Waterbury.		
1619	Liberty Corn and All Crops 2-8-2	2-8-2	Middletown
1618	Liberty Corn, Fruit and All Crops, 2-12-4.	2-12-4	Middletown
2322	Liberty Corn and Vegetable, 3-6-10	3-6-10	Greenwich
1609	Liberty Fish, Bone and Potash, 3-10-4	3-10-4	Broad Brook
1622	Liberty Market Gardener's Special, 4-8-4.	4-8-4	Cheshire
1623	Liberty High Grade Market Gardener's, 5-8-7	5-8-7	West Cheshire
2492	Liberty High Grade Market Gardener's, 5-8-7	5-8-7	Middletown

CONTAINING NITROGEN, PHOSPHORIC ACID AND POTASH.

Nitrogen.					Phosphoric Acid.			Potash.		
In ammonia.	Organic water-soluble.	Organic water-insoluble.	Total.	Ammonia equivalent to total nitrogen.	Citrate-insoluble.	Total.	So-called "Available."	As muriate.	Total.	Station No.
%	%	%	%	%	%	%	%	%	%	
0.35	0.62	0.46	2.57	3.12	0.83	9.06	8.23	3.93	3.93	2020
0.71	0.55	0.58	1.97	2.40	0.88	9.15	8.27	3.01	3.01	2029
0.71	0.17	2.95	4.21	5.12	0.28	4.40	4.12	0.44	5.08	2028
1.00	0.48	0.36	1.98	2.41	0.61	10.55	9.94	2.80	2.80	2024
1.09	0.45	0.55	2.45	2.98	0.82	10.50	9.68	3.20	3.20	2027
2.56	0.23	0.57	5.04	6.13	0.33	6.70	6.37	3.99	3.99	2022
1.67	0.61	0.52	3.23	3.93	1.10	8.90	7.80	6.66	6.66	2025
0.43	0.63	0.62	1.74	2.11	0.90	9.00	8.10	2.07	2.07	2018
0.26	0.33	1.57	2.58	3.14	1.54	11.30	9.76	2.06	2.06	2331
1.73	0.61	0.53	3.29	4.00	0.94	8.66	7.72	6.90	6.90	2306
0.69	0.07	2.98	4.14	5.03	0.26	4.21	3.95	0.47	5.49	2311
0.84	0.57	0.34	1.80	2.19	0.63	10.58	9.95	2.33	2.33	2021
0.36	0.39	0.39	1.30	1.58	0.80	8.92	8.12	2.25	2.25	2019
1.26	0.50	1.00	3.17	3.85	0.61	8.46	7.85	4.05	4.05	2315
0.69	0.48	0.60	1.84	2.24	0.78	8.65	7.87	3.06	3.06	2026
1.35	0.42	0.52	2.47	3.00	0.79	8.69	7.90	3.79	3.79	2304
1.48	0.49	0.44	2.56	3.11	0.72	10.55	9.83	3.85	3.85	1624
1.43	0.55	0.43	2.53	3.08	0.70	10.80	10.10	3.63	3.63	2500
0.70	0.18	2.82	4.14	5.03	0.26	4.53	4.27	0.41	5.44	2314
1.67	0.47	0.55	3.23	3.93	0.66	8.57	7.91	4.24	4.24	2307
1.00	0.32	0.60	2.44	2.97	0.66	9.06	8.40	3.66	3.66	2312
0.66	0.54	0.58	1.93	2.35	0.68	8.46	7.78	3.05	3.05	2308
1.70	0.57	0.55	3.36	4.09	0.99	8.93	7.94	7.12	7.12	2310
0.71	0.43	4.29	5.98	7.27	0.29	3.88	3.59	0.69	7.50	2309
1.25	0.27	0.66	2.50	3.04	0.58	10.67	10.09	3.38	3.38	2313
0.76	0.51	0.35	1.66	2.02	0.63	10.62	9.99	2.04	2.04	2321
1.83	0.11	0.61	3.36	4.09	0.39	8.59	8.20	6.65	6.65	2327
0.57	0.45	0.56	1.72	2.09	0.49	8.41	7.92	2.78	2.78	2326
0.64	0.23	4.47	5.92	7.20	0.31	4.08	3.77	0.69	7.61	2329
0.69	0.00	2.93	4.13	5.02	0.20	4.53	4.33	0.52	5.36	2330
0.27	0.22	0.52	2.12	2.58	1.56	10.11	8.55	3.31	3.31	1619
1.24	0.41	0.14	1.82	2.21	1.32	13.70	12.38	4.16	4.16	1618
1.55	0.14	0.32	2.84	3.45	0.64	7.22	6.58	10.82	10.82	2322
1.56	0.79	0.21	2.60	3.16	0.90	11.15	10.25	4.02	4.02	1609
2.02	0.21	0.30	3.42	4.16	1.20	9.40	8.20	4.35	4.35	1622
2.84	0.22	0.14	4.12	5.01	0.88	9.08	8.20	6.85	6.85	1623
2.83	0.23	0.13	4.16	5.06	0.90	9.15	8.25	6.78	6.78	2492

TABLE XIII. ANALYSES OF MIXED FERTILIZERS

Station No.	Manufacturer and Brand.	Grade.	Place of Sampli
	Sampled by Station:		
	Apothecaries Hall Co., Waterbury—*Con.*		
2323	Liberty High Grade Tobacco Manure ...	7.5-4-7.5	East Windsor
1617	Liberty Tobacco Special, 5-4-5	5-4-5	Middletown ..
2324	Liberty Top Dresser Grass and Grain, 10-3.5-8	10-3.5-8	East Windsor
1613	Liberty Top Dresser	7-8-3	Broad Brook .
	Armour Fertilizer Works, New York.		
1625	Armour's Big Crop Fertilizer, 3-8-4	3-8-4	Thompsonville
2055	Armour's Big Crop Fertilizer, 4-6-10	4-6-10	Ansonia .....
2047	Armour's Big Crop, 4-8-4	4-8-4	Milford ......
2048	Armour's Big Crop, 5-8-5	5-8-5	Milford ......
2058	Armour's Big Crop Tobacco Special	5-4-5	Thompsonville
2054	Armour's Corn Grower, 2-8-2	2-8-2	Danbury .....
2495	Armour's Big Crop Fertilizer, 5-8-7	5-8-7	Ansonia ......
1773	Armour's Big Crop Fertilizer, 5-8-7	5-8-7	Wallingford ..
	Atlantic Packing Co., New Haven.		
2355	Atlantic, 5-4-16	5-4-16	Glastonbury .
2056	Atlantic Corn and Grain Fertilizer, 2-8-2..	2-8-2	Waterbury ...
2328	Atlantic Market Garden, 4-8-6	4-8-6	Silver Lane ..
2057	Atlantic Special Vegetable and Potato Grower, 4-8-4	4-8-4	Waterbury ...
2356	Atlantic Tobacco Grower, 5-4-5	5-4-5	Glastonbury .
2352	Atlantic Tobacco Manure, 5-8-6	5-8-6	Silver Lane ..
2639	Atlantic Special, 3-8-4	3-8-4	Waterbury ...
	F. A. Bartlett Tree Expert Co., Stamford.		
1842	Bartlett's Green Tree Food	6-8-4	Sampled at Fa[illegible]
	Berkshire Fertilizer Co., Bridgeport.		
2351	Berkshire Complete Fertilizer	3-8-3	Waterbury ...
1843	Berkshire Complete Tobacco	5-4-5	Suffield ......
1844	Berkshire Economical Grass Fertilizer ..	10-3-8	Suffield ......
2350	Berkshire Grass Special	7-2-4	Waterbury ...
2348	Berkshire Long Island Special	5-8-7	Suffield ......
1840	Berkshire Market Garden	4-8-4	Milford ......
1841	Berkshire Potato and Vegetable Phosphate	2-8-4	Southport ....
2347	Berkshire Tobacco Special	7-4-7	Suffield ......
	F. E. Boardman, Middletown.		
2354	Boardman's Fertilizer for Potatoes and General Crops	4-7-4	Sampled at Fa[illegible]
2353	Boardman's Tobacco Fertilizer	4-7-4	Sampled at Fa[illegible]

CONTAINING NITROGEN, PHOSPHORIC ACID AND POTASH—*Continued.*

Nitrogen.				Ammonia equivalent to total nitrogen.	Phosphoric Acid.			Potash.		Station No.
In ammonia.	Organic water-soluble.	Organic water-insoluble.	Total.		Citrate-insoluble.	Total.	So-called "Available."	As muriate.	Total.	
%	%	%	%	%	%	%	%	%	%	
1.18	0.56	3.82	6.06	7.37	0.26	5.84	5.58	1.44	8.65	2323
1.22	0.32	2.82	4.44	5.40	0.30	6.45	6.15	0.93	4.61	1617
0.00	0.25	1.08	8.52	10.36	3.07	7.95	4.88	8.88	8.88	2324
3.71	0.01	0.15	5.76	7.00	0.63	8.90	8.27	3.50	3.50	1613
1.69	0.38	0.53	2.64	3.21	0.78	9.13	8.35	3.86	3.86	1625
1.27	0.28	0.61	3.26	3.96	0.43	6.85	6.42	10.07	10.07	2055
1.34	0.33	0.86	3.25	3.95	0.28	8.40	8.12	4.48	4.48	2047
1.76	0.96	0.81	3.93	4.78	0.55	8.70	8.15	4.98	4.98	2048
0.16	0.02	3.33	4.11	5.00	0.45	5.10	4.65	0.47	5.18	2058
1.13	0.33	0.62	2.12	2.58	0.61	8.60	7.99	3.06	3.06	2054
1.68	0.38	0.80	3.85	4.68	0.83	8.88	8.05	6.68	6.68	2495
1.72	0.62	0.60	3.86	4.69	0.48	8.25	7.77	7.29	7.29	1773
1.01	0.30	1.49	4.29	5.22	3.48	9.85	6.37	0.82	16.71	2355
0.89	0.20	0.56	1.67	2.03	0.65	8.65	8.00	2.19	2.19	2056
1.04	0.36	0.89	3.17	3.85	0.46	9.05	8.59	6.08	6.08	2328
1.36	0.43	0.80	3.28	3.99	0.70	8.95	8.25	4.27	4.27	2057
0.75	0.62	1.75	4.17	5.07	0.33	5.45	5.12	0.37	5.52	2356
1.39	0.50	0.81	3.97	4.83	0.83	9.33	8.50	0.66	6.17	2352
1.00	0.34	0.70	2.58	3.14	0.75	9.45	8.70	4.01	4.01	2639
4.50	0.22	0.72	5.66	6.88	3.07	9.65	6.58	4.67	4.67	1842
1.74	0.17	0.98	2.97	3.61	0.60	9.20	8.60	3.82	3.82	2351
0.75	0.59	3.56	4.90	5.96	0.38	4.68	4.30	0.66	5.43	1843
3.73	0.38	2.11	8.19	9.96	4.83	9.78	4.95	9.30	9.30	1844
0.56	0.00	1.11	6.16	7.49	1.78	6.00	4.22	4.25	4.25	2350
1.74	0.04	1.32	4.50	5.47	0.63	9.00	8.37	8.84	8.84	2348
1.31	0.19	0.95	3.46	4.21	1.03	9.08	8.05	4.89	4.89	1840
0.87	0.21	0.61	1.76	2.14	1.15	9.40	8.25	4.57	4.57	1841
2.03	0.20	3.94	6.44	7.83	0.15	4.90	4.75	1.01	6.75	2347
1.32	0.23	1.42	3.67	4.46	0.73	8.65	7.92	4.43	4.43	2354
1.22	0.21	1.83	3.74	4.55	0.25	7.90	7.65	1.34	5.12	2353

TABLE XIII. ANALYSES OF MIXED FERTILIZERS

Station No.	Manufacturer and Brand.	Grade.	Place of Samp
	Sampled by Station:		
	Bowker Fertilizer Co., New York.		
2365	Bowker's All Round Fertilizer	3-8-4	New Canaan
2375	Bowker's Hill and Drill Phosphate	3-10-4	Hazardville .
1645	Bowker's Fisherman's Brand Fish and Potash	3-10-3	Yalesville ...
1644	Bowker's Market Garden Fertilizer	4-8-4	Yalesville ...
2494	Bowker's Market Garden Fertilizer	4-8-4	New Canaan
1858	Bowker's Potato and Vegetable Phosphate	2-8-3	Meriden ....
2349	Bowker's Square Brand Farm and Garden Phosphate	2-10-2	Willimantic .
1867	Bowker's Sure Crop Phosphate	1-8-2	Willimantic .
2370	Stockbridge Potato and Vegetable Manure	4-6-10	Willimantic .
2376	Stockbridge Premier Tobacco Grower ...	7-3-7	West Suffield
1626	Stockbridge Tobacco Manure	5-4-5	Thompsonvill
2366	Stockbridge Top Dressing and Forcing Manure	6-6-4	Meriden ....
1857	Stockbridge Truck Manure	4-8-7	Yalesville ...
2493	Stockbridge Truck Manure	4-8-7	Milldale .....
	Amos D. Bridge's Sons, Inc., Hazardville.		
1859	Corn, Onion, Potato and General Purpose Fertilizer	4-8-4	Sampled at Fa
2640	Special Tobacco Fertilizer	5-4-5	Sampled at Fa
	E. D. Chittenden Co., Bridgeport.		
1636	Chittenden's Complete Grain, 3% Potash	2-8-3	Rockville ...
2369	Chittenden's High Grade Potato	5-8-7	Glastonbury .
2368	Chittenden's High Grade Tobacco	6-3-7.5	Glastonbury .
2372	Chittenden's Potato Special, 4% Potash ..	4-8-4	Bloomfield ..
2371	Chittenden's Potato Special, 6% Potash ..	4-8-6	Bloomfield ..
2526	Chittenden's Potato Special, 6% Potash ..	4-8-6	Abington ...
2374	Chittenden's Tobacco Special, 5% Potash	5-4-5	Glastonbury
2411	Chittenden's Top Dresser, 4% Potash ...	6-8-4	Glastonbury
	Everett B. Clark Seed Co., Milford.		
1638	Clark's Special Mixture for General Use.	4-8-4	Branford ....
1637	Clark's Special Mixture with 6% Potash..	4-8-6	Branford ....
1865	Clark's Super Phosphate	5-8-7	Sampled at Fa
1864	Clark's Tip Top Brand	5-10-5	Orange .....
1868	Clark's Tip Top Brand	5-10-5	Allingtown .
	Davey Tree Expert Co., Kent, Ohio.		
2416	Davey Tree Food	7-8-3	Greenwich ..

CONTAINING NITROGEN, PHOSPHORIC ACID AND POTASH—*Continued.*

Nitrogen.				Ammonia equivalent to total nitrogen.	Phosphoric Acid.			Potash.		Station No.
In ammonia.	Organic water-soluble.	Organic water-insoluble.	Total.		Citrate-insoluble.	Total.	So-called "Available."	As muriate.	Total.	
%	%	%	%	%	%	%	%	%	%	
1.21	0.44	0.58	2.46	2.99	0.85	9.00	8.15	4.27	4.27	2365
1.03	0.22	0.77	2.60	3.16	0.85	10.93	10.08	3.06	4.15	2375
0.83	0.42	0.56	2.36	2.87	0.70	10.46	9.76	2.99	2.99	1645
1.71	0.48	0.52	3.15	3.83	0.93	8.93	8.00	4.87	4.87	1644
1.72	0.57	0.51	3.19	3.88	0.78	8.98	8.20	3.98	3.98	2494
0.72	0.49	0.56	1.85	2.25	0.72	8.60	7.88	3.11	3.11	1858
0.72	0.11	0.52	1.66	2.02	0.53	11.18	10.65	2.54	2.54	2349
0.32	0.28	0.28	0.88	1.07	0.50	8.50	8.00	2.12	2.12	1867
1.55	0.41	0.52	3.10	3.77	0.50	6.70	6.20	10.25	10.25	2370
0.83	0.61	4.33	5.94	7.22	0.35	4.10	3.75	0.72	7.24	2376
0.69	0.00	2.90	4.08	4.96	0.33	4.63	4.30	0.31	5.30	1626
2.50	0.22	0.55	5.08	6.18	0.43	6.55	6.12	3.79	3.79	2366
1.64	0.56	0.51	3.18	3.87	0.93	9.10	8.17	6.04	6.04	1857
1.68	0.67	0.53	3.36	4.09	1.14	8.96	7.82	6.75	6.75	2493
1.14	0.17	0.96	3.50	4.26	1.28	10.10	8.82	0.90	4.54	1859
1.10	0.78	2.24	4.26	5.18	0.60	5.85	5.25	0.98	6.10	2640
0.74	0.35	0.40	1.59	1.93	0.78	8.76	7.98	3.18	3.18	1636
2.39	0.21	0.59	3.91	4.75	0.45	9.40	8.95	6.70	6.70	2369
2.73	0.44	2.07	5.38	6.54	0.15	4.25	4.10	0.44	8.36	2368
1.54	0.03	0.72	3.13	3.81	0.73	8.73	8.00	4.51	4.51	2372
1.45	0.13	0.57	2.84	3.45	0.65	9.08	8.43	5.38	5.38	2371
1.53	0.76	0.64	2.96	3.60	0.65	8.85	8.20	5.38	5.38	2526
2.55	0.14	1.28	4.22	5.13	0.35	5.13	4.78	2.23	5.47	2374
2.85	0.13	0.59	4.14	5.03	0.50	9.00	8.50	4.71	4.71	2411
1.99	0.22	1.23	3.50	4.26	2.40	10.70	8.30	1.70	4.19	1638
1.92	0.37	1.05	3.40	4.13	1.35	9.85	8.50	6.42	6.74	1637
2.14	0.38	0.72	3.99	4.85	1.05	9.48	8.43	6.48	6.48	1865
2.22	0.37	0.86	4.27	5.19	1.22	10.63	9.41	2.54	4.81	1864
....	....	....	4.03	4.90	0.90	10.84	9.94	....	5.89	1868
2.37	0.81	2.13	5.34	6.49	4.15	12.85	8.70	3.56	3.56	2416

TABLE XIII. ANALYSES OF MIXED FERTILIZERS

Station No.	Manufacturer and Brand.	Grade.	Place of Sampli
	Sampled by Station: **Eastern States Farmers' Exchange, Springfield, Mass.**		
1706	Eastern States 3-12-3	3-12-3	Newtown ....
1775	Eastern States 3-12-3	3-12-3	South Windsor
1705	Eastern States 4-8-10	4-8-10	Danbury .....
1641	Eastern States 5-8-7	5-8-7	North Haven
1903	Eastern States 5-8-7	5-8-7	Woodstock ..
1902	Eastern States 5-10-5	5-10-5	Woodstock ..
2405	Eastern States 8-6-6	8-6-6	Danbury .....
2413	Eastern States Formula A Tobacco Fertilizer	6.5-4.2-5.5	Ellington ....
2415	Eastern States Formula B	6-4-5.2	Warehouse Poi
2414	Eastern States Formula C Tobacco Fertilizer	6.5-4.2-5.5	Glastonbury .
	Essex Fertilizer Co., Boston.		
1700	Essex 2-8-2 Farm and Garden	2-8-2	Wallingford ..
1639	Essex Fish Fertilizer for All Crops, 3-8-4	3-8-4	Wallingford ..
1640	Essex Market Garden for Potatoes, Roots and Vegetables, 4-8-4	4-8-4	Wallingford ..
2412	Essex Special Tobacco, 5-4-5	5-4-5	Rockville ....
	L. T. Frisbie Co., New Haven.		
1703	Frisbie's 5-8-7	5-8-7	Danbury .....
2124	Frisbie's 5-8-7	5-8-7	Wethersfield .
1704	Frisbie's Corn and Grain Fertilizer, 2-8-2.	2-8-2	Danbury .....
2130	Frisbie's Market Garden, 4-8-6	4-8-6	Winsted ......
2126	Frisbie's Special, 3-8-4	3-8-4	New Britain ..
2125	Frisbie's Special Vegetable and Potato Grower, 4-8-4	4-8-4	Wethersfield .
2132	Frisbie's Tobacco Grower, 5-4-5	5-4-5	Thompsonville
2131	Frisbie's Tobacco Manure, 5-8-6	5-8-6	Windsor Locks
2127	Frisbie's Top Dresser, 7-5-4	7-5-4	Sampled at Fac
	A .W. Higgins, South Deerfield, Mass.		
2145	Old Deerfield 4-8-4 Complete Fertilizer ..	4-8-4	Madison ......
2144	Old Deerfield 5-8-7 Complete Fertilizer ..	5-8-7	Madison ......
	International Agricultural Corp., Woburn, Mass.		
2409	International Conn. Valley Special	7-6-5	Glastonbury .
1684	International Conn. Valley Special	7-6-5	Manchester ..
2436	International Economy	2-8-2	Guilford .....
2437	International General Favorite	3-8-6	Cromwell ....

CONTAINING NITROGEN, PHOSPHORIC ACID AND POTASH—*Continued.*

Nitrogen.				Ammonia equivalent to total nitrogen.	Phosphoric Acid.			Potash.		Station No.
In ammonia.	Organic water-soluble.	Organic water-insoluble.	Total.		Citrate-insoluble.	Total.	So-called "Available."	As muriate.	Total.	
%	%	%	%	%	%	%	%	%	%	
1.48	0.41	0.28	2.54	3.09	0.70	12.78	12.08	3.62	3.62	1706
1.41	0.36	0.56	2.88	3.50	0.23	12.83	12.60	3.37	3.37	1775
2.12	0.61	0.65	3.91	4.75	0.75	9.60	8.95	8.29	8.29	1705
2.09	0.29	0.66	3.85	4.68	0.40	8.70	8.30	7.12	7.12	1641
....	....	....	3.49	4.24	0.53	8.83	8.30	6.56	6.56	1903
2.87	0.75	0.43	4.11	5.00	0.88	11.05	10.17	5.30	5.30	1902
4.65	0.86	0.71	6.32	7.68	0.35	6.90	6.55	6.80	6.80	2405
0.59	0.60	3.38	5.31	6.46	0.28	6.83	6.55	1.14	5.92	2413
0.98	0.52	3.00	5.02	6.10	0.23	5.38	5.15	1.42	6.66	2415
1.08	1.28	2.90	5.45	6.63	2.30	6.88	4.58	0.49	5.59	2414
0.84	0.26	0.54	1.72	2.09	0.77	8.84	8.07	2.18	2.18	1700
1.48	0.32	0.72	2.58	3.14	0.88	9.00	8.12	4.61	4.61	1639
1.48	0.58	0.91	3.35	4.07	0.78	9.13	8.35	4.31	4.31	1640
0.16	0.22	1.88	3.74	4.55	0.65	5.70	5.05	1.65	5.55	2412
1.91	0.67	0.80	4.02	4.89	0.70	9.63	8.93	6.93	6.93	1703
1.97	0.56	0.80	4.02	4.89	0.78	9.43	8.65	6.88	6.88	2124
0.83	0.27	0.54	1.68	2.04	0.63	8.65	8.02	1.99	1.99	1704
0.95	0.53	0.77	3.30	4.01	0.65	9.23	8.58	6.02	6.02	2130
1.03	0.42	0.73	2.68	3.26	0.75	9.48	8.73	4.37	4.37	2126
1.91	0.53	0.63	3.26	3.96	0.60	9.13	8.53	4.24	4.24	2125
1.25	0.63	1.75	4.13	5.02	0.25	5.23	4.98	0.36	5.61	2132
1.39	0.77	0.79	4.22	5.13	0.68	9.25	8.57	0.62	6.08	2131
2.73	0.52	0.72	5.64	6.86	0.40	6.00	5.60	4.48	4.48	2127
1.40	0.30	1.00	3.39	4.12	1.56	9.05	7.49	5.32	5.32	2145
1.47	0.73	1.19	4.17	5.07	2.43	10.15	7.72	6.81	6.81	2144
2.40	0.21	3.06	5.77	7.02	0.83	7.00	6.17	0.57	5.58	2409
2.51	0.29	2.90	5.70	6.93	0.20	6.28	6.08	0.52	5.27	1684
1.26	0.16	0.44	1.93	2.35	0.25	8.28	8.03	2.53	2.53	2436
1.42	0.53	0.42	2.45	2.98	0.30	8.58	8.28	6.24	6.24	2437

TABLE XIII. ANALYSES OF MIXED FERTILIZERS

Station No.	Manufacturer and Brand.	Grade.	Place of Sampli
	Sampled by Station: **International Agricultural Corp., Woburn, Mass.**—*Continued.*		
1659	International High Grade Manure	4-6-10	Manchester ..
2503	International High Grade Manure	4-6-10	Warehouse Poi
2410	International Multiple Strength, 10-8-10..	10-8-10	Glastonbury .
1658	International New England Special	2-12-4	Manchester ..
1635	International Tobacco Grower	5-6-7	Manchester ..
2502	International Tobacco Grower	5-6-7	Warehouse Poi
2442	International Tobacco Producer	5-4-5	Hazardville ..
2678	International Tobacco Producer	5-4-5	Broad Brook .
1634	International Tobacco Special	7-3-7	Manchester ..
	Lowell Fertilizer Co., Boston, Mass.		
1657	Lowell Animal Brand, A High Grade Manure for All Crops, 3-8-4	3-8-4	Suffield ......
1707	Lowell Bone Fertilizer for Corn, Grain, Grass and Vegetables, 2-8-2	2-8-2	Southbury ...
1708	Lowell Potato Phosphate for Potatoes and Vegetables, 4-8-7	4-8-7	Southbury ...
2087	Lowell 4-6-10, Potatoes and Vegetables ..	4-6-10	Moosup ......
1710	Lowell 4-8-4 for Potatos, Corn and Vegetables	4-8-4	Warehouse Poi
2082	Lowell 5-8-7 for Potatoes and Vegetables	5-8-7	Warehouse Poi
2084	Lowell Tobacco 5-4-5 for Tobacco, Fruits and Vines	5-4-5	Manchester ..
2083	Lowell Top Dressing, 7-5-2	7-5-2	Manchester ..
2498	Lowell Top Dressing, 7-5-2	7-5-2	Warehouse Poi
	Mapes Formula and Peruvian Guano Co., New York.		
1655	The Mapes Connecticut Valley Special ..	6-4-7	Hartford .....
1653	The Mapes Corn Manure	3-8-3	Hartford ....
1699	The Mapes General Tobacco Manure ...	5-4-5	Hartford ....
1654	The Mapes General Truck Manure	5-8-5	Hartford ....
1662	The Mapes General Use Manure	3-6-4	Meriden .....
2435	The Mapes Onion Manure	4-6-4	Hartford .....
1661	The Mapes Potato Manure	4-7-5	Meriden .....
1918	The Mapes Tobacco, Ash Constituents ..	1-4-15	East Granby ..
2441	The Mapes Special Formula Tobacco Manure	6-4-3	Hartford .....
1702	The Mapes Tobacco Manure Wrapper Brand	7.5-2-10.5	Ellington ....
1656	The Mapes Tobacco Starter, Improved ..	5-6-1	Windsor Locks
2434	The Mapes Top Dresser	10-4-2	Hartford .....

Containing Nitrogen, Phosphoric Acid and Potash—*Continued.*

Nitrogen.					Phosphoric Acid.			Potash.		
In ammonia.	Organic water-soluble.	Organic water-insoluble.	Total.	Ammonia equivalent to total nitrogen.	Citrate-insoluble.	Total.	So-called "Available."	As muriate.	Total.	Station No.
%	%	%	%	%	%	%	%	%	%	
1.76	0.88	0.50	3.14	3.82	0.43	7.15	6.72	9.10	9.10	1659
1.86	0.48	0.67	3.07	3.73	0.40	7.53	7.13	9.52	9.52	2503
5.19	0.09	2.78	8.26	10.04	0.40	8.35	7.95	1.18	10.34	2410
0.62	0.24	0.36	1.58	1.92	0.45	12.50	12.05	4.18	4.18	1658
1.98	0.19	2.20	4.43	5.39	0.20	5.69	5.49	0.74	7.08	1635
1.86	0.14	2.04	4.14	5.03	0.31	6.04	5.73	1.69	7.51	2502
1.84	0.13	1.66	3.74	4.55	0.15	3.99	3.84	1.30	5.42	2442
....	....	....	4.10	4.98	0.23	4.25	4.02	....	5.05	2678
2.48	0.29	2.91	5.78	7.03	0.28	3.78	3.50	0.56	6.86	1634
1.39	0.34	0.74	2.47	3.00	0.85	8.97	8.12	4.38	4.38	1657
0.66	0.49	0.57	1.91	2.32	0.75	8.64	7.89	2.13	2.13	1707
1.14	0.77	0.81	3.56	4.33	1.24	9.00	7.76	7.78	7.78	1708
2.02	0.61	0.66	3.42	4.16	0.78	7.23	6.45	10.81	10.81	2087
1.02	0.62	0.87	3.24	3.94	1.00	9.18	8.18	4.40	4.40	1710
1.75	0.85	1.03	4.43	5.39	1.33	9.33	8.00	7.00	7.00	2082
0.10	0.35	2.11	4.11	5.00	0.70	5.73	5.03	1.14	5.59	2084
5.28	0.00	0.08	5.36	6.52	0.10	5.74	5.64	2.46	2.46	2083
5.81	0.00	0.11	5.92	7.20	0.53	5.21	4.68	2.07	2.07	2498
0.33	0.72	1.76	4.95	6.02	0.63	5.15	4.52	0.78	9.30	1655
0.70	0.38	1.04	2.24	2.72	1.75	10.70	8.95	2.88	3.52	1653
0.39	0.75	1.46	4.53	5.51	1.54	5.26	3.72	0.54	5.69	1699
1.17	0.33	1.20	3.84	4.67	0.75	8.78	8.03	4.13	5.50	1654
0.90	0.23	0.92	2.82	3.43	0.73	8.68	7.95	0.35	4.90	1662
1.18	0.22	0.95	3.64	4.43	1.38	8.48	7.10	0.07	5.19	2435
1.10	0.23	0.96	3.42	4.16	1.00	9.33	8.33	4.65	5.36	1661
0.18	0.25	0.50	1.02	1.24	1.23	6.00	4.77	0.88	15.15	1918
0.37	0.86	1.61	4.64	5.64	1.68	5.75	4.07	0.62	5.85	2441
0.39	1.22	2.45	6.20	7.54	1.90	5.10	3.20	0.78	11.46	1702
1.23	0.28	1.31	4.15	5.05	1.98	9.60	7.62	1.18	2.55	1656
1.84	0.48	1.03	8.25	10.03	0.93	6.20	5.27	0.35	3.13	2434

TABLE XIII. ANALYSES OF MIXED FERTILIZERS

Station No.	Manufacturer and Brand.	Grade.	Place of Sampling.
	Sampled by Station:		
	New England Fertilizer Co., Boston.		
1660	New England Corn Phosphate for Grain and Vegetables, 2-8-2	2-8-2	Rockville
2081	New England Corn Phosphate for Grain and Vegetables, 2-8-2	2-8-2	Meriden
1913	New England 5-8-7 for Potatoes and Market Garden	5-8-7	Meriden
2509	New England 5-8-7 for Potatoes and Market Garden	5-8-7	Rockville
1709	New England 4-8-4 for Potatoes, Vegetables and Grass	4-8-4	Meriden
1912	New England Potato Phosphate 4-8-7 for Potatoes and Vegetables	4-8-7	Plainville
1663	New England Superphosphate, A High Grade Fertilizer for All Crops, 3-8-4	3-8-4	Plainville
2444	New England Tobacco, 5-4-5	5-4-5	Warehouse Point
2443	New England Tobacco Manure, 5-8-6	5-8-6	Warehouse Point
	Olds & Whipple, Inc., Hartford.		
1919	O & W Blue Label Brand Tobacco Fertilizer	6-3-6	Glastonbury
1910	O & W Complete Corn, Potato and Onion Fertilizer	4-8-4	South Mancheste
1730	O & W Complete Tobacco Fertilizer	5-4-5	South Mancheste
1732	O & W High Grade Potato Fertilizer	5-8-7	Silver Lane
1914	O & W High Grade Starter and Potash Compound	5-4-15	South Windsor
1911	O & W Special Complete Corn, Onion and Potato Fertilizer	3-8-2	South Mancheste
	Parmenter & Polsey, Boston, Mass.		
2643	P & P Farm and Garden, 2-8-2	2-8-2	Stafford Springs
2146	P & P Plymouth Rock Brand for All Crops, 3-8-4	3-8-4	Stafford Springs
2642	P & P Potato and Market Garden, 5-8-7	5-8-7	Stafford Springs
	Piedmont Mt. Airy Guano Co., Baltimore, Md.		
2097	Harvest Brand, 2-8-2	2-8-2	Guilford
1528	Harvest Brand, 3-8-4	3-8-4	New Haven
1736	Harvest Brand, 4-8-4	4-8-4	Seymour
2510	Harvest Brand, 4-8-4	4-8-4	Guilford
1771	Harvest Brand, 4-6-10	4-6-10	New Haven
1526	Harvest Brand, 5-8-5	5-8-5	New Haven

Containing Nitrogen, Phosphoric Acid and Potash—*Continued.*

Nitrogen.						Ammonia equivalent to total nitrogen.	Phosphoric Acid.			Potash.		Station No.
In nitrates.	In ammonia.	Organic water-soluble.	Organic water-insoluble.	Total.			Citrate-insoluble.	Total.	So-called "Available."	As muriate.	Total.	
%	%	%	%	%		%	%	%	%	%	%	
.13	1.09	0.32	0.44	1.98		2.41	0.70	7.98	7.28	2.10	2.10	1660
.09	0.78	0.28	0.64	1.79		2.18	0.72	8.57	7.85	2.37	2.37	2081
.77	1.85	0.26	0.96	3.84		4.67	0.80	8.95	8.15	7.34	7.34	1913
.83	1.51	0.89	0.92	4.15		5.05	1.59	8.83	7.24	7.43	7.43	2509
.31	1.48	0.61	0.92	3.32		4.04	0.93	9.23	8.30	4.23	4.23	1709
.79	0.95	0.73	0.70	3.17		3.85	1.10	9.58	8.48	7.14	7.14	1912
.23	1.21	0.32	0.64	2.40		2.92	0.68	8.58	7.90	3.97	3.97	1663
.66	0.10	0.34	2.18	4.28		5.20	0.63	5.50	4.87	1.62	5.37	2444
.58	0.14	0.55	2.10	4.37		5.31	1.43	9.83	8.40	1.82	6.18	2443
.11	0.02	0.24	4.02	5.39		6.55	0.38	3.90	3.52	0.58	7.36	1909
.24	1.24	0.00	0.88	3.36		4.09	0.93	9.55	8.62	4.72	4.72	1910
.09	0.04	0.26	2.94	4.33		5.26	0.45	5.40	4.95	0.49	5.95	1730
.51	2.08	0.65	1.18	4.42		5.37	1.20	10.18	8.98	0.66	7.80	1732
.47	0.80	0.17	1.82	4.26		5.18	0.60	5.48	4.88	1.30	16.12	1914
.58	0.00	0.20	0.94	2.72		3.31	1.23	11.20	9.97	2.60	2.60	1911
.38	0.33	0.53	0.76	2.00		2.43	0.63	8.78	8.15	2.02	2.02	2643
.22	1.19	0.26	0.70	2.37		2.88	0.75	8.89	8.14	4.32	4.32	2146
.84	1.68	0.81	0.94	4.27		5.19	1.35	9.08	7.73	7.50	7.50	2642
.05	0.97	0.59	0.39	2.00		2.43	0.70	8.85	8.15	3.93	3.93	2097
.14	2.12	0.50	0.42	3.18		3.87	0.50	9.00	8.50	4.00	4.00	1528
.00	2.34	0.64	0.36	3.34		4.06	0.82	8.18	7.36	3.90	3.90	1736
.07	2.25	0.52	0.46	3.30		4.01	1 02	8.25	7.23	3.94	3.94	2510
.08	2.06	0.67	0.36	3.17		3.85	0.50	7.00	6.50	9.77	9.77	1771
.12	2.38	0.75	0.83	4.08		4.96	0.98	9.70	8.72	5.19	5.19	1526

TABLE XIII. ANALYSES OF MIXED FERTILIZERS

Station No.	Manufacturer and Brand.	Grade.	Place of Sampling.
	Sampled by Station: **Piedmont Mt. Airy Guano Co., Baltimore, Md.**		
2143	Harvest Brand, 5-8-7	5-8-7	Torrington
2139	Harvest Brand, 8-6-6	8-6-6	Seymour
2511	Harvest Brand, 8-6-6	8-6-6	Guilford
2641	Harvest Brand, 6-8-6	6-8-6	Rockville
	Frank S. Platt Co., New Haven.		
1733	Platco Special	4-8-6	Sampled at Factor
	Rackliffe Bros. Co., New Britain.		
2459	Rackliffe 4-8-4 Fertilizer	4-8-4	Southington
	The Rogers & Hubbard Co., Portland.		
1742	4-8-4	4-8-4	Hartford
2142	5-8-7	5-8-7	Wethersfield
1743	Garden Fertilizer	2-8-4	Hartford
1627	Hubbard's "Bone Base" Fertilizer for Oats and Top Dressing	10-3-8	Talcottville
1620	Hubbard's "Bone Base" Fertilizer for Seeding Down	3-5-6	Sampled at Facto
2519	Hubbard's "Bone Base" Fertilizer for Seeding Down	3-5-6	Sampled at Facto
2085	Hubbard's "Bone Base" Soluble Corn and General Crops Manure	3-8-6	Norwich
2086	Hubbard's "Bone Base" Soluble Potato Manure	6-8-5	Cromwell
2103	Rogers & Hubbard's All Soils, All Crops	4-10-4	Ellington
2147	Rogers & Hubbard's Climax Tobacco Brand	5-4-5	Granby
2104	Rogers & Hubbard's Corn and Grain Fertilizer	1-10-3	Willimantic
2101	Rogers & Hubbard's High Potash Fertilizer	3-8-10	Branford
2107	Rogers & Hubbard's Potato Fertilizer	2-10-4	New Britain
2095	Rogers & Hubbard's Tobacco Grower Vegetable Formula	6-4-4	Burnside
	F. S. Royster Guano Co., Baltimore, Md.		
2099	Royster's Bully Guano	2-8-5	Trumbull
2105	Royster's Quality Trucker	4-8-7	Waterbury
2100	Royster's Triumph Guano	3-8-3	Thompsonville
2098	Royster's Trucker's Delight	4-8-4	Plainville
2513	Royster's Trucker's Delight	4-8-4	Granby
2149	Royster's Valley Tobacco Formula	5-4-5	Granby
2148	Royster's Wrapper Brand	7-3-7	Granby

CONTAINING NITROGEN, PHOSPHORIC ACID AND POTASH—*Continued.*

	Nitrogen.				Ammonia equivalent to total nitrogen.	Phosphoric Acid.			Potash.		Station No.
	In ammonia.	Organic water-soluble.	Organic water-insoluble.	Total.		Citrate-insoluble.	Total.	So-called "Available."	As muriate.	Total.	
	%	%	%	%	%	%	%	%	%	%	
1	2.86	0.55	0.38	3.90	4.74	1.10	8.94	7.84	7.71	7.71	2143
4	5.32	0.58	0.54	6.58	8.00	0.70	7.10	6.40	5.48	5.48	2139
)0	4.00	0.68	0.59	5.27	6.41	0.90	6.83	5.93	10.14	10.14	2511
4	3.97	0.56	0.35	5.02	6.10	0.75	9.35	8.60	0.76	4.91	2641
2	0.12	0.73	0.78	3.25	3.95	1.38	9.65	8.27	2.33	6.17	1733
1	0.11	0.48	1.11	3.41	4.14	1.53	9.70	8.17	4.51	4.51	2459
8	1.90	0.59	0.62	3.29	4.00	2.64	10.85	8.21	4.33	4.33	1742
26	1.06	0.52	0.58	4.42	5.37	2.28	10.60	8.32	6.75	6.75	2142
0	0.90	0.43	0.46	1.89	2.30	2.65	11.20	8.55	4.54	4.54	1743
9	0.00	0.00	0.41	8.70	10.58	2.48	8.00	5.52	7.35	8.58	1627
13	0.18	0.50	1.71	2.82	3.43	4.05	11.60	7.55	7.14	7.14	1620
51	0.06	0.21	1.67	2.55	3.10	6.33	13.05	6.72	6.01	6.01	2519
3	0.07	0.38	0.81	2.49	3.03	2.55	10.83	8.28	5.84	5.84	2085
7	1.18	0.98	0.63	4.96	6.03	1.88	10.80	8.92	0.47	5.00	2086
26	2.00	0.61	0.61	3.48	4.23	3.13	12.88	9.75	4.58	4.58	2103
20	0.14	0.27	2.55	4.16	5.06	0.60	6.00	5.40	0.86	5.65	2147
)2	0.13	0.33	0.44	0.92	1.12	1.23	11.60	10.37	3.21	3.21	2104
)4	1.31	0.69	0.60	2.64	3.21	3.25	11.25	8.00	10.67	10.67	2101
)9	0.55	0.64	0.54	1.82	2.21	2.97	12.91	9.94	4.50	4.50	2107
25	0.09	0.19	3.56	5.09	6.19	0.90	5.33	4.43	0.35	4.21	2095
5	0.92	0.00	0.54	1.61	1.96	1.33	9.70	8.37	4.66	4.66	2099
)8	2.07	0.07	0.96	3.18	3.87	0.90	9.55	8.65	7.17	7.17	2105
11	1.47	0.11	0.79	2.48	3.02	1.40	9.60	8.20	3.17	3.17	2100
1	2.04	0.16	0.70	3.01	3.66	1.05	9.40	8.35	3.99	3.99	2098
2	1.83	0.23	1.02	3.20	3.89	1.60	9.59	7.99	4.14	4.14	2513
35	0.87	0.06	2.47	3.75	4.56	0.23	4.30	4.07	0.44	5.21	2149
38	1.47	0.70	3.56	6.11	7.43	0.30	3.80	3.50	0.56	7.92	2148

TABLE XIII. ANALYSES OF MIXED FERTILIZERS

Station No.	Manufacturer and Brand.	Grade.	Place of Sampling
	Sampled by Station:		
	Sanderson Fertilizer and Chemical Co., New Haven.		
2155	Sanderson's Atlantic Coast Bone, Fish and Potash	3-10-3	Guilford
1748	Sanderson's Complete Tobacco Grower	5-4-5	Manchester
2141	Sanderson's Corn Superphosphate	2-8-3	Hamden
1747	Sanderson's Formula A	4-8-4	Guilford
2121	Sanderson's Formula B	4-8-6	Bloomfield
2140	Sanderson's Potato Manure	3-8-4	Hamden
2164	Sanderson's Top Dressing Grass and Grain	6-6-4	Unionville
	M. L. Shoemaker & Co., Philadelphia.		
2158	Shoemaker's "Swift-Sure" Special Tobacco Formula	4-8-5	New Milford
1751	Shoemaker's "Swift-Sure" Tobacco and General Use	3-10-3	New Milford
	Springfield Rendering Co., Springfield, Mass.		
1767	Springfield Animal Brand, 3-8-4	3-8-4	Thompsonville
1769	Springfield Market Garden Grower and Top Dresser, 5-8-7	5-8-7	Hazardville
2461	Springfield Tobacco Special, 5-4-5	5-4-5	Thompsonville
1768	Springfield Spec. Potato, Onion and Vegetable, 4-8-4	4-8-4	Hazardville
	I. P. Thomas & Son, Philadelphia, Pa.		
1457	I. P. Thomas, 5-8-7	5-8-7	Highwood
1459	Truckers' High Grade Guano, 4-8-4	4-8-4	Highwood
1556	Improved Truckers' Fertilizer	5-10-5	Highwood
2129	Improved Truckers' Fertilizer	5-10-5	Highwood
	Triton Oil and Fertilizer Co., New York City.		
2162	Triton 3-10-2 Fertilizer	3-10-2	New London
2159	Triton 4-8-4 Fertilizer	4-8-4	New London
2160	Triton 4-8-7 Fertilizer	4-8-7	New London
2161	Triton 5-8-7 Fertilizer	5-8-7	New London
	U. S. Guano Co., Baltimore, Md.		
2183	Standard United States Evergreen Fish Guano	4-8-4	Plantsville
2497	Standard United States Farmers' Formula	8-6-6	New Britain
2455	Standard United States Fish, Bone and Potash	5-8-7	Plantsville

CONTAINING NITROGEN, PHOSPHORIC ACID AND POTASH—*Continued.*

	Nitrogen.					Phosphoric Acid.			Potash.		
	In ammonia.	Organic water-soluble.	Organic water-insoluble.	Total.	Ammonia equivalent to *total* nitrogen.	Citrate-insoluble.	Total.	So-called "Available."	As muriate.	Total.	Station No.
	%	%	%	%	%	%	%	%	%	%	
1	1.09	0.57	0.56	2.53	3.08	0.88	10.75	9.87	3.36	3.36	2155
3	0.68	0.24	2.85	4.20	5.11	0.30	4.63	4.33	0.51	5.27	1748
2	0.74	0.50	0.52	1.88	2.29	0.80	8.80	8.00	3.26	3.26	2141
9	1.69	0.61	0.48	3.27	3.98	0.75	9.01	8.26	4.00	4.00	1747
1	1.07	0.22	1.36	3.36	4.09	1.03	9.95	8.92	0.56	5.94	2121
9	1.35	0.46	0.50	2.50	3.04	0.75	8.80	8.05	3.93	3.93	2140
9	2.50	0.25	0.57	4.81	5.85	0.43	6.80	6.37	3.84	3.84	2164
2	0.08	0.43	1.89	3.52	4.28	2.58	11.10	8.54	1.26	5.57	2158
8	0.07	0.46	1.07	2.58	3.14	3.90	14.45	10.55	1.37	3.72	1751
3	1.60	0.45	0.55	2.64	3.21	0.50	8.89	8.39	4.21	4.21	1767
1	1.89	0.53	0.81	4.04	4.91	0.55	9.23	8.68	7.39	7.39	1769
4	0.09	0.41	2.24	3.98	4.84	1.08	6.90	5.82	0.61	5.52	2461
0	1.44	0.60	0.60	3.34	4.06	0.65	9.01	8.36	4.12	4.12	1768
4	2.02	0.18	0.61	4.05	4.92	1.23	10.94	9.71	6.77	6.77	1457
2	1.20	0.34	0.55	3.11	3.78	1.32	9.08	7.76	4.23	4.23	1459
0	1.72	0.13	0.72	3.77	4.58	1.15	11.88	10.73	4.66	5.04	1556
1	1.69	0.40	0.72	4.02	4.89	1.10	11.93	10.83	4.96	4.96	2129
2	1.50	0.00	0.80	2.72	3.31	0.10	10.80	10.70	2.41	2.41	2162
4	1.26	0.48	1.24	3.52	4.28	0.88	8.62	7.74	4.17	4.17	2159
8	1.32	0.82	0.80	3.42	4.16	0.88	9.03	8.15	6.47	6.47	2160
1	2.06	0.24	0.87	3.98	4.84	1.28	9.78	8.50	7.00	7.00	2161
6	2.24	0.23	1.06	3.79	4.61	1.88	10.00	8.12	2.15	3.54	2183
0	5.02	0.13	0.25	5.50	6.69	1.18	9.30	8.12	6.54	6.54	2497
5	3.24	0.22	0.41	4.02	4.89	0.58	9.30	8.72	7.05	7.05	2455

TABLE XIII. ANALYSES OF MIXED FERTILIZERS

Station No.	Manufacturer and Brand.	Grade.	Place of Samplin
	Sampled by Station: **Virginia-Carolina Chemical Co., New York City.**		
1766	V-C Aroostook Potato Grower	5-8-7	North Haven .
2157	V-C Champion Brand	4-8-4	North Haven .
2165	V-C Double Owl Brand	4-8-6	North Haven .
1765	V-C Good Luck Brand	3-10-5	North Haven .
1770	V-C Indian Chief Brand	5-4-5	Glastonbury ..
2182	*V-C National Brand*	4-8-10	North Haven .
2156	V-C Tip Top Top Dresser	6-8-4	North Haven .
	Wilcox Fertilizer Co., Mystic.		
1810	Wilcox 4-8-4 Fertilizer	4-8-4	Willimantic ...
1816	Wilcox 5-8-7 Fertilizer	5-8-7	Norwich ......
2187	Wilcox 5-10-5 Fertilizer	5-10-5	Sampled at Fact
2191	Wilcox Corn Special	3-10-4	Ellington .....
2512	Wilcox Corn Special	3-10-4	Sampled at Fact
1811	Wilcox Fish and Potash	3-8-3	Willimantic ...
2186	Wilcox Grass and Truck Fertilizer	5-8-4	Sampled at Fact
1812	Wilcox Potato and Vegetable Phosphate	4-8-6	Willimantic ....
2190	Wilcox Tobacco Special	5-4-5	Ellington ......
2189	Wilcox Top Dresser	8-6-6	Sampled at Fact
	S. D. Woodruff & Sons, Orange.		
1772	Woodruff's Home Mixture	4-8-6	North Haven ..
	Worcester Rendering Co., Auburn, Mass.		
2192	Prosperity Complete Dressing, 6-6-3	6-6-3	Putnam ....
2193	Prosperity Corn and Grain Fertilizer	2-8-2	Putnam ....
1817	Prosperity Market Garden Fertilizer	5-8-7	Norwich ....
1815	Prosperity Potato and Vegetable	4-8-4	Norwich ....
1845	Prosperity Potato and Vegetable, 4-8-4..	4-8-4	Norwich ....
2185	Prosperity Superior Top Dressing	8-6-6	North Stoningto

CONTAINING NITROGEN, PHOSPHORIC ACID AND POTASH—*Concluded.*

	Nitrogen.				Ammonia equivalent to total nitrogen.	Phosphoric Acid.			Potash.		Station No.
	In ammonia.	Organic water-soluble.	Organic water-insoluble.	Total.		Citrate-insoluble.	Total.	So-called "Available."	As muriate.	Total.	
	%	%	%	%	%	%	%	%	%	%	
.14	2.92	0.52	0.26	3.84	4.67	1.35	9.70	8.35	7.32	7.32	1766
.19	2.17	0.46	0.25	3.07	3.73	1.05	9.25	8.20	4.12	4.12	2157
.10	2.66	0.53	0.19	3.48	4.23	1.23	8.85	7.62	6.22	6.22	2165
.12	1.60	0.57	0.21	2.50	3.04	1.80	11.93	10.13	4.66	5.43	1765
.23	0.63	0.19	2.86	3.91	4.75	0.45	4.76	4.31	0.45	6.22	1770
.00	2.78	0.43	0.22	3.43	4.17	1.46	9.00	7.54	10.92	10.92	2182
.13	4.19	0.45	0.29	5.06	6.15	1.38	9.05	7.67	4.11	4.11	2156
.83	0.19	0.66	0.75	3.43	4.17	0.85	9.20	8.35	4.36	4.36	1810
.95	0.09	0.80	1.40	4.24	5.15	2.30	10.65	8.35	5.41	6.95	1816
.01	0.10	0.76	1.12	3.99	4.85	2.23	11.83	9.60	5.15	5.15	2187
.26	0.12	0.38	0.71	2.47	3.00	0.45	10.30	9.85	3.27	3.27	2191
.84	0.60	0.50	0.70	2.64	3.21	0.50	10.38	9.88	3.23	3.23	2512
.46	0.18	0.60	0.84	3.08	3.74	0.58	9.02	8.44	3.69	3.69	1811
.18	2.02	0.10	0.87	4.17	5.07	0.10	9.00	8.90	4.42	4.42	2186
.65	0.09	0.67	0.76	3.17	3.85	1.35	9.45	8.10	2.43	6.16	1812
.05	0.22	0.49	4.48	6.24	7.59	0.13	6.05	5.92	0.76	6.90	2190
.31	0.08	1.10	2.53	7.02	8.53	1.15	7.53	6.38	5.65	6.04	2189
.16	0.02	0.03	1.86	3.07	3.73	1.55	9.48	7.93	6.18	6.18	1772
.36	0.12	1.09	1.37	4.94	6.01	0.83	7.03	6.20	3.27	3.27	2192
.54	0.88	0.36	0.52	2.30	2.80	0.68	8.70	8.02	2.30	2.30	2193
.06	1.50	0.77	0.88	4.21	5.12	0.65	8.63	7.98	6.49	6.49	1817
.86	1.38	0.51	0.84	3.59	4.36	0.75	9.60	8.85	4.54	4.54	1815
.65	1.47	0.33	0.78	3.23	3.93	0.60	9.20	8.60	4.81	4.81	1845
.09	0.17	2.46	1.74	6.46	7.85	1.13	7.90	6.77	4.84	4.84	2185

TABLE XIII. ANALYSES OF MIXED FERTILIZERS

Station No.	Manufacturer and Brand.	Grade.	Place of Sampling.
	Sampled by Purchaser:		
	American Agricultural Chemical Co., New York City		
2043	Double A Tobacco Fertilizer, 173,839	5-4-5	Granby ....
2044	Double A Tobacco Fertilizer, 75,100	5-4-5	Granby ....
2045	Double A Tobacco Fertilizer, 7,301	5-4-5	Granby ....
2046	Double A Tobacco Fertilizer, 571,689	5-4-5	Granby ....
1718	Quinnipiac Seed Leaf Tobacco Manure ..	....	Broad Brook ..
1649	Quinnipiac Prime Tobacco Manure, 63,858	7-3-7	Hartford ......
	Apothecaries Hall Co., Waterbury.		
641	Fertilizer, 8-4-5 (Light)	8-4-5	Buckland ......
642	Fertilizer, 8-4-5 (Dark)	8-4-5	Buckland ......
	Eastern States Farmers' Exchange, Springfield, Mass.		
2557	5-10-5 Fertilizer	5-10-5	Saybrook ......
2065	Eastern States, 5-8-7	5-8-7	Farmington ....
	L. T. Frisbie Co., New Haven.		
2424	Frisbie's 5-8-7	5-8-7	Manchester ....
	The Rogers & Hubbard Co., Portland.		
1595	Rogers & Hubbard Tobacco Grower Vegetable Formula	6-4-4	Burnside ....
923	Seeding Down Fertilizer	....	Sent from Factoi
1795	....	....	*Hartford* ......

CONTAINING NITROGEN, PHOSPHORIC ACID AND POTASH—*Concluded.*

Nitrogen.					Ammonia equivalent to total nitrogen.	Phosphoric Acid.			Potash.		Station No.
In nitrates.	In ammonia.	Organic water-soluble.	Organic water-insoluble.	Total.		Citrate-insoluble.	Total.	So-called "Available."	As muriate.	Total.	
%	%	%	%	%	%	%	%	%	%	%	
...	....	....	....	4.24	5.15	0.35	4.90	4.55	....	4.62	2043
...	....	....	....	4.36	5.30	0.43	5.68	5.25	....	4.65	2044
...	....	....	....	4.13	5.02	0.45	4.63	4.18	....	4.99	2045
...	....	....	....	4.23	5.14	0.40	4.43	4.03	....	5.03	2046
...	....	....	....	4.14	5.03	0.27	4.23	3.96	0.40	4.84	1718
...	....	....	....	5.91	7.19	0.38	3.70	3.32	0.54	6.80	1649
...	....	....	....	6.70	8.15	....	....	....	....	....	641
...	....	....	....	6.32	7.68	....	....	....	....	....	642
...	....	....	....	3.30	4.01	....	11.16	....	....	5.00	2557
...	....	....	....	4.78	5.81	0.35	7.89	7.54	....	7.98	2065
...	....	....	....	3.92	4.90	0.75	9.60	8.85	....	7.05	2424
...	....	....	....	5.11	6.21	0.92	5.30	4.38	....	4.32	1595
...	....	....	....	....	....	5.68	12.60	6.92	....	....	923
...	....	....	....	5.05	6.14	0.45	6.25	5.80	....	6.83	1795

SPECIAL MIXTURES AND HOME MIXTURES.

Forty-six samples of home mixed goods and fertilizers mixed by manufacturers according to special formulas required by the purchasers have been analyzed and are reported in Table XVI. Only three of these were sampled by the station agent.

TABLE XVI. ANALYSES OF SPECIAL MIXTURES AND HOME MIXTURES.

Station No.	Manufacturer.	Place of Sampling.	Total nitrogen.	Ammonia equivalent to total nitrogen.	Phosphoric Acid. Citrate-insoluble.	Phosphoric Acid. Total.	Phosphoric Acid. So-called "available."	Potash. As muriate.	Potash. Total.	Station No.
	Sampled by Station:		%	%	%	%	%	%	%	
1774	Eastern States Farmers' Exchange, Springfield, Mass.	L. W. Newberry, So. Windsor	6.00	7.29	0.45	6.60	6.15	1.13	8.63	1774
1523	....	T. W. Ryan, Stratford	4.82	5.86	0.65	8.03	7.38	....	7.71	1523
1524	....	T. W. Ryan, Stratford	4.12	5.01	0.93	10.68	9.75	....	6.09	1524
	Sampled by Purchaser:									
1222	Formula A	American Sumatra Tobacco Co., Bloomfield	5.36	6.52	0.23	4.94	4.71	0.16	6.22	1222
1399	Formula A	" "	5.24	6.37	0.18	4.54	4.36	....	6.08	1399
1422	Formula A	" "	5.39	6.55	0.18	4.78	4.60	0.32	6.11	1422
1353	Formula AA	" "	6.92	8.41	0.46	3.91	3.45	0.29	1.09	1353
1401	Formula AA	" "	7.02	8.53	0.46	3.98	3.52	....	1.13	1401
1223	Formula B	" "	5.74	6.98	0.28	4.53	4.25	0.15	6.95	1223
1400	Formula B	" "	5.59	6.80	0.19	5.42	5.23	....	7.03	1400
1423	Formula B	" "	5.22	6.35	0.19	5.04	4.85	0.28	6.20	1423
1573	Formula C	" "	6.16	7.49	0.30	5.08	4.78	0.27	6.57	1573
1420	Formula D	" "	5.31	6.46	1.22	6.10	4.88	0.20	6.07	1420
1421	Formula F	" "	5.20	6.32	1.38	6.64	5.26	0.16	4.94	1421
1473	Formula G	" "	5.86	7.12	0.26	4.12	3.86	0.40	5.37	1473
1452	Formula H	" "	4.80	5.84	0.20	5.19	4.99	0.54	7.65	1452
1574	Formula H	" "	5.19	6.31	0.28	5.58	5.30	0.43	5.48	1574
1474	Formula I	" "	5.26	6.40	0.24	4.80	4.56	0.37	6.19	1474
1537	Formula J	" "	5.80	7.05	0.28	6.04	5.76	....	7.20	1537
1696	Formula K	" "	5.97	7.26	0.25	5.70	5.45	0.25	7.02	1696
1697	Formula N	" "	5.42	6.59	0.28	5.45	5.17	0.44	8.07	1697

TABLE XVI. ANALYSES OF SPECIAL MIXTURES AND HOME MIXTURES—*Continued.*

Station No.	Manufacturer.	Place of Sampling.	Total nitrogen.	Ammonia equivalent to total nitrogen.	Phosphoric Acid. Citrate-insoluble.	Phosphoric Acid. Total.	Phosphoric Acid. So-called "available."	Potash. As muriate.	Potash. Total.	Station No.
	Sampled by Purchaser:		%	%	%	%	%	%	%	
1698	Formula O	American Sumatra Tobacco Co., Bloomfield	7.06	8.58	0.73	4.85	4.12	0.57	1.36	1698
1601	Old Formula	" "	5.88	7.15	0.20	5.90	5.70	....	4.07	1601
2116	....	George Bostick, Sr., Thompsonville	5.86	7.12	0.23	5.18	4.95	0.40	7.66	2116
2117	....	W. J. Burgess, Thompsonville	4.20	5.11	0.28	4.53	4.25	....	4.41	2117
2118	....	James T. Burgess, Thompsonville	5.93	7.21	0.15	5.55	5.40	....	6.93	2118
2014	....	O. W. Murphy, Collinsville ..	1.20	1.46	3.43	11.60	8.17	....	3.25	2014
2015	....	O. W. Murphy, Collinsville ..	4.92	5.98	0.88	5.65	4.77	....	3.72	2015
2197	Apothecaries Hall Co., Waterbury	Fred Hoffman, Ellington	6.25	7.60	0.78	4.54	3.76	1.66	7.79	2197
2198	Apothecaries Hall Co., Waterbury	Fred Hoffman, Ellington	3.37	4.10	0.70	8.60	7.90	....	4.44	2198
2361	Apothecaries Hall Co., Waterbury	Stamford Mason's Supply Co., Stamford	3.34	4.06	1.09	9.68	8.59	....	4.07	2361
2364*	Apothecaries Hall Co., Waterbury	W. J. Burgess, Thompsonville	5.65	6.87	0.30	5.78	5.48	....	9.09	2364
2196	Berkshire Fertilizer Co., Bridgeport	Fred Hoffman, Ellington	6.02	7.32	0.18	4.20	4.02	0.66	7.89	2196
2318	Berkshire Fertilizer Co., Bridgeport	Louis Grouboush, Suffield ...	4.20	5.11	0.63	5.18	4.55	....	5.70	2318
2319	Berkshire Fertilizer Co., Bridgeport	Neland Loomis, Suffield	4.94	6.01	0.85	6.05	5.20	....	3.74	2319
1906	Everett B. Clark Seed Co., Milford	Angelo Cerrone, Northford ..	4.83	5.87	1.86	10.40	8.54	....	7.31	1906

TABLE XVI. ANALYSES OF SPECIAL MIXTURES AND HOME MIXTURES—*Concluded.*

Station No.	Manufacturer.	Place of Sampling.	Total nitrogen.	Ammonia equivalent to total nitrogen.	Phosphoric Acid. Citrate-insoluble.	Phosphoric Acid. Total.	Phosphoric Acid. So-called "available."	Potash. As muriate.	Potash. Total.	Station No.
	Sampled by Purchaser:		%	%	%	%	%	%	%	
1893	L. T. Frisbie Co., New Haven	C. R. Burr & Co., Manchester	3.85	4.68	0.68	9.13	8.45	....	6.83	1893
2035	Olds & Whipple, Inc., Hartford	H. E. Wells, Warehouse Point	5.50	6.69	1.10	6.00	4.90	....	12.00	2035
2036	Olds & Whipple, Inc., Hartford	H. E. Wells, Warehouse Point	5.38	6.54	1.15	5.95	4.80	....	11.79	2036
2037	Olds & Whipple, Inc., Hartford	H. E. Wells, Warehouse Point	4.60	5.59	1.20	9.93	8.73	....	8.14	2037
2385	The Rogers & Hubbard Co., Portland	A. N. Shepard & Son, Hartford	4.95	6.02	0.83	5.55	4.72	....	4.19	2385
2386	The Rogers & Hubbard Co., Portland	A. N. Shepard & Son, Hartford	4.91	5.97	0.88	5.63	4.75	....	4.33	2386
2387	The Rogers & Hubbard Co., Portland	A. N. Shepard & Son, Hartford	5.24	6.37	0.73	5.64	4.91	....	4.67	2387
1820	Sanderson Fertilizer & Chemical Co., New Haven	American Sumatra Tobacco Co., Bloomfield	3.34	4.06	1.08	9.80	8.72	....	5.19	1820
1821	Sanderson Fertilizer & Chemical Co., New Haven	American Sumatra Tobacco Co., Bloomfield	1.92	2.33	1.03	9.13	8.10	....	3.16	1821
2110	Wilcox Fertilizer Co., Mystic	E. C. Pendleton, Norwich	5.14	6.25	0.55	9.50	8.95	0.52	7.26	2110

VII. MISCELLANEOUS FERTILIZERS, AMENDMENTS AND WASTE PRODUCTS.

WOOD ASHES.

Twelve samples of wood ashes, chiefly Canadian products, have been analyzed. All were of good quality. Nine contained over 6 per cent of potash and eleven contained over 5 per cent. Besides potash, wood ashes contain from 1.5 to 2.5 per cent of phosphoric acid and probably 30 per cent or more of lime which contribute to their value as a fertilizer and a soil amendment, but as a source of potash at $5.00 per unit they are expensive.

Analyses are given in Table XVII.

TABLE XVII. ANALYSES OF WOOD ASHES.

Station No.	Manufacturer.	Purchaser.	Phosphoric acid.	Water-soluble potash.
	Sampled by Station:		%	%
1776	John Joynt, Lucknow, Canada	Gordon Scholes, Warehouse Point	1.68	6.25
1901	" "	Harry Zera, Suffield	2.10	6.22
	Sampled by Purchaser:			
1633	John Joynt, Lucknow, Canada	The Allied Tobacco Company, Hartford	1.73	6.41
1722	" "	" "	2.15	4.79
1907	" "	" "	1.75	6.16
1908	" "	" "	2.38	6.65
1675	" "	F. R. & R. M. Goodrich, Portland	2.15	5.60
1598	" "	Hatheway & Steane, Inc., Hartford	2.50	6.75
1599	" "	" "	2.25	6.50
1669	" "	" "	2.20	6.18
2317	" "	" "	2.13	5.26
1796	" "	L. Wetstone & Sons, Hartford	1.98	5.97

TABLE XVIII. ANALYSES OF

Station No.	Manufacturer or Brand.	Place of Sampling.
	Sampled by Station:	
2305	American Agricultural Chemical Co., New York City	Morrison & Dunham, Bethel
2051	Armour Fertilizer Works, New York City	F. A. Bartlett Tree Expert Co., Stamford ....
2123	*Berkshire Fertilizer Co., Bridgeport*	Factory ....
1866	Case's Brand. A. H. Case & Co., Inc., Buffalo, N. Y.	W. L. Thorpe, North Haven
1652	Sheep's Head. Natural Guano Co., Aurora, Illinois	Cadwell & Jones, Hartford
1728	Groz-It. Pacific Manure & Fertilizer Co., San Francisco, Cal.	Meech & Stoddard, Inc., Middletown ....
1725	Premier Poultry Manure. Premier Poultry Manure Co., Chicago, Illinois	Lightbourn & Pond, New Haven ....
1726	Premier Sheep Manure. Premier Poultry Manure Co., Chicago, Illinois	Lightbourn & Pond, New Haven ....
1729	Wizard Brand Manure. The Pulverized Manure Co., Chicago, Illinois	W. W. Hunt & Co., Hartford ....
1734	Wizard Brand Sheep Manure. The Pulverized Manure Co., Chicago, Illinois	F. H. Liggett & Co., Stamford ....
1744	So. American Sheep and Goat Manure. Sanderson Fertilizer & Chemical Co., New Haven..	G. W. Thorpe, West Cheshire ....

Sheep Manure, Etc.

Total nitrogen.	Ammonia equivalent to total nitrogen.		Phosphoric Acid.				Potash.		Station No.
			Available.		Total.				
	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.	
%	%	%	%	%	%	%	%	%	
1.06	2.38	1.75	....	....	0.78	0.75	2.03	2.00	2305
1.39	1.69	1.50	....	....	0.98	1.00	3.19	2.00	2051
2.10	2.55	2.18	1.85	1.00	1.93	....	3.30	2.00	2123
2.15	2.61	1.21	....	....	1.95	1.25	1.63	1.00	1866
2.52	3.06	2.73	1.72	1.00	1.90	1.25	2.27	2.00	1652
1.68	2.04	1.82	0.71	0.75	0.88	1.25	2.79	3.00	1728
5.21	6.33	6.00	2.75	2.50	2.93	2.75	1.42	1.30	1725
2.62	3.19	3.00	1.25	1.00	1.45	1.50	1.91	2.00	1726
1.94	2.36	2.10	0.78	1.00	0.95	....	1.78	1.00	1729
2.38	2.89	2.43	1.35	1.25	1.53	....	2.56	2.00	1734
1.30	1.58	1.50	....	....	0.90	1.00	3.21	2.50	1744

SHEEP MANURE, ETC.

Analyses of eleven samples of sheep and other farm manures, all sampled by the station agent, are given in Table XVIII. All guaranties for nitrogen and potash were substantially met or exceeded; and there were no notable deficiencies in phosphoric acid.

The character of the nitrogen in sheep manure is shown by analyses of several brands sampled in 1924. Nitrogen distribution was determined as shown in the subjoined summary.

Sample No.	Total Nitrogen.	Insoluble Organic Nitrogen.	Active Insoluble Organic Nitrogen (Alkaline Method).	Per cent Active.
	%	%	%	%
22982	2.47	1.96	0.62	31.4
22983	2.07	1.85	0.66	35.8
22986	1.30	1.12	0.37	33.6
22991	1.33	1.12	0.45	40.2
23457	1.81	1.76	0.39	22.2

These figures show that organic nitrogen insoluble in water comprises the greater part of the total nitrogen; and that from 20 to 40 per cent of the insoluble nitrogen is "active" by one of the conventional methods for determining its activity. This parallels rather closely field experiments which have shown that only about one-third of the nitrogen in manure is recovered in the first year's crop and that its full quota of plant food is not utilized except over a period of years. It is recognized, however, that the value of farm manures is not confined to the commercial value of the nitrogen, phosphorus and potash which they contain. Their chief value perhaps lies in the fact that they serve as conditioners and as culture media for the growth of beneficial soil bacteria.

LIME, ETC.

Seventeen samples of liming materials, chiefly limestone, have been analyzed and are summarized in Table XIX. A discussion on the classification and uses of lime was given in our report last year.[1]

Sample **2362** was carbide residue about which information as to its utilization was asked. This material is the residue obtained in the manufacture of acetylene gas. It is useful as a source of lime for agricultural purposes if it is dry and otherwise in good mechanical condition. It should be exposed to the air to dispel traces of acetylene gas which would be injurious to seed. If applied to the soil 2 or 3 weeks before planting there should be no danger. The sample examined contained 47.3 per cent of lime (CaO), and had apparently been well exposed as the calcium was largely in the air-slaked condition.

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[1] Conn. Exp. Sta., Bull. 261, p. 92 (1924).

TABLE XIX. ANALYSES OF

Station No.	Manufacturer or Brand.	Sampled by.
	Ground Limestone, Etc.	
	Manufacturer Unknown.	
1567	65016	American Sumatra Tobacco Co., Bloomfield
	Coe Lime Works, Northford.	
960	Ground Limestone	Sidney Edwards, Middletown
1204	Ground Limestone	Sidney Edwards, Middletown
1460	Ground Limestone	J. S. Owens, Ext. Agronomist, Storrs
1532	Ground Limestone	J. S. Owens, Ext. Agronomist, Storrs
2302	Ground Limestone	Sidney Edwards, Middletown
2501	Ground Limestone	Station Agent from Factory, Northford
	Farnam Cheshire Lime Co., Farnams, Mass.	
2346	Agricultural Lime	Station Agent from E. Delage & Sons, Plainville
	Grangers Mfg. Co., West Stockbridge, Mass.	
620	Agricultural Limestone	J. W. Alsop, Avon
621	Agricultural Limestone	Conn. Sumatra Tobacco Co., Buckland
1404	Agricultural Limestone	Winchell Smith, Farmington
1694	Agricultural Limestone	American Sumatra Tobacco Co., Bloomfield
1695	Agricultural Limestone	American Sumatra Tobacco Co., Bloomfield
2301	Ground Limestone	Sidney Edwards, Middletown
2454	Agricultural Limestone	Station Agent from J. F. Raven Hardware Co. Meriden
	Miscellaneous.	
2362	Carbide residue	N. Y., N. H. & H. R. R., New Haven
2398	Waste Lime	J. B. Tinker, Canaan

Limestone, Etc.

Chemical Analysis.						Mechanical Analysis.					
ime (CaO).		Magnesia (MgO)									
Found.	Guaranteed.	Found.	Guaranteed.	Total Oxides.	Insoluble in acid.	20 mesh.	40 mesh.	50 mesh.	80 mesh.	100 mesh.	Station No.
%	%	%	%	%	%	%	%	%	%	%	
.83	....	4.03	....	65.86	....	97.50	91.00	83.50	70.50	66.50	1567
.15	....	0.67	....	53.82	2.90	....	....	....	....	....	960
.45	....	0.99	....	52.44	5.61	89.00	75.00	64.50	54.00	50.50	1204
...	....	....	....	....	....	73.00	54.00	45.00	37.50	35.50	1460
...	....	....	....	....	....	85.00	69.50	60.50	52.50	49.50	1532
.25	....	1.00	....	54.25	3.92	60.00	44.50	37.50	31.50	29.50	2302
.96	....	0.54	....	52.50	3.79	73.30	56.60	46.60	37.60	30.40	2501
.25	60.00	0.15	0.00	60.40	1.79	94.00	72.00	55.00	39.00	33.00	2346
.68	....	0.66	....	51.34	8.43	....	....	....	....	....	620
.58	....	0.66	....	51.24	8.40	....	....	....	....	....	621
...	....	....	....	....	....	100.00	91.00	77.00	61.00	55.00	1404
.66	....	8.31	....	47.97	11.98	100.00	100.00	98.00	93.00	90.00	1694
.68	....	8.56	....	48.24	11.92	100.00	100.00	98.00	....	88.00	1695
.38	....	11.40	....	50.78	6.71	97.00	87.00	81.00	75.00	71.00	2301
.67	....	7.96	....	46.63	12.00	97.50	86.00	74.70	61.20	55.10	2454
.33	....	0.21	....	47.54	1.20	....	....	....	....	....	2362
.10	....	11.27	....	42.37	....	....	....	....	....	....	2398

MISCELLANEOUS.

Seventy-six samples of miscellaneous material have been analyzed, most of which need no individual discussion.

This number includes thirteen samples submitted by the Tobacco Experiment Station which have been examined in some detail and are reported upon in Table XX.

There are included also, nine samples of check fertilizers in the coöperative program of the Royster Guano Co., and thirty samples of check cottonseed meals in a similar program of the American Oil Chemists' Society. The complete list is as follows:

Raw materials for Tobacco Station	13
Check fertilizers	9
Check cottonseed meals	30
Potash marl	1
Tobacco stems, dust, etc.	13
Soil	3
Other miscellaneous	7
Total	76

TABLE XX. ANALYSES OF MATERIAL SUBMITTED BY TOBACCO STATION.*

Materials.	Water and Undetermined.	Organic Matter.	Nitrogen.	Phosphorus Pentoxide (P_2O_5).	Potassium Oxide (K_2O).	Calcium Oxide (CaO).	Magnesium Oxide (MgO).	Iron and Aluminum Oxides (Fe_2O_3 & Al_2O_3).	Sulphur Trioxide (SO_3).	Sodium Oxide (NA_2O).	Chlorine (CL).	Silica (SiO_2).
	%	%	%	%	%	%	%	%	%	%	%	%
Cottonseed Meal	6.75	86.87[1]	6.72	2.64	1.98	0.27	1.07	0.06	....	....	0.00	0.13
Castor Pomace	7.50	86.85[1]	5.01	1.47	0.55	0.88	0.67	0.19	....	....	0.08	1.03
Sodium Nitrate	48.54[2]	....	15.46	....	....	....	....	....	....	35.66	0.34	....
Precipitated Bone	....	....	....	38.32[3]	....	....	....	....	....	....	....	....
Potassium Sulphate	2.87[4]	....	....	....	50.09	0.11	1.25	0.33	43.32	0.02[5]	1.75	0.65
Potassium Carbonate	36.43[6]	....	....	....	62.73	....	....	....	....	....	0.84	....
Tankage	8.45	78.20[1]	9.51	4.53	0.26	5.10	0.29	0.60	2.60	....	0.31	1.27
Ammonium Sulphate	19.85	....	20.78	....	....	....	....	....	59.37	....	....	....
Dry Ground Fish	7.57	73.52[1]	9.16	7.33[7]	0.60	8.01	0.35	0.39	2.84	....	0.28	1.38
Double Manure Salts	9.74[4]	....	....	....	27.36	1.17	10.28	0.86	46.27	0.94[5]	1.68	2.08
Trona Potash	1.03[4]	....	....	....	60.94	0.00	0.04	0.11	0.27	2.49[5]	45.10[8]	0.20
Urea	....	....	46.20[9]	....	....	....	....	....	....	....	....	....
Green Sand Marl	7.43[4]	....	....	1.25[10]	6.59[11]	1.75	3.82	26.50	0.88	0.48	....	49.86

*Analyses by Mr. H. J. Fisher.
[1] The nitrogen given in next column is included here, it being principally in organic form.
[2] Of this, 44.14% is oxygen.
[3] 37.73% available.
[4] Loss on ignition.
[5] By difference.
[6] Mostly CO_2.
[7] 5.58% available.
[8] Oxygen equivalent to chlorine 10.18%.
[9] Urea 99.03%.
[10] 0.35% available.
[11] Water-soluble potash 0.10%.

1727. *Potash Marl.* Potash Marl, Inc., New York. Sampled by station agent, stock of Lightbourn and Pond, New Haven.

Analysis:

Available phosphoric acid 0.45 per cent; total phosphoric acid 1.33 per cent. The material was guaranteed 0.25 and 1 per cent of available and total phosphoric acid respectively.

Only phosphoric acid is guaranteed. The material contains, or may contain, 6 per cent or more of potash but it is largely or entirely insoluble in water. The product was quoted at $43.00 per ton but the plant food in it cannot be valued at over $5.00. We have no information that its worth as an amendment justifies the extra cost.

922. *Tobacco Stems,* unground, submitted by W. A. Henry & Sons, Wallingford.

933. *Tobacco Dust,* ground, submitted by Edw. Eggert, Hartford.

2555, 2556. *Tobacco Dust,* submitted by S. D. Woodruff Sons, Orange.

955. *Tobacco Stems,* ground, submitted by the Everett B. Clark Seed Co., Milford.

2558. *Tobacco Butts,* **2559** Tips, **2560** Tips, **2561** Middle leaf, **2562** Middle leaf, **2563** Tips, **2564** Butts, **2565** Middle leaf. Submitted by Dr. Anderson, Tobacco Station, Windsor, for determinations of moisture only.

Analyses of these tobaccos are given in the following tabulation.

ANALYSES OF TOBACCO.

Sta. No.	Moisture. %	Nitrogen. %	Phosphoric. %	Potash. %	Nicotine. %
922	30.50	1.41	0.38	5.82	....
933	....	2.71	0.43	2.83	1.03
2555	....	1.96	....	2.14	....
2556	....	1.84	....	1.61	....
955	....	1.48	....	6.01	....
2558	27.29	....	....	....	....
2559	24.91	....	....	....	....
2560	23.71	....	....	....	....
2561	26.99	....	....	....	....
2562	28.27	....	....	....	....
2563	20.01	....	....	....	....
2564	23.47	....	....	....	....
2565	21.24	....	....	....	....

BULLETIN 271 JANUARY, 1926

Connecticut Agricultural Experiment Station

New Haven, Connecticut

Spray Bulletin

BY

W. E. BRITTON, *Entomologist.*

AND

G. P. CLINTON, *Botanist.*

The Bulletins of this Station are mailed free to citizens of Connecticut who apply for them, and to other applicants as far as the editions permit.

BULLETIN 271

JANUARY, 1926

Connecticut Agricultural Experiment Statio

NEW HAVEN, CONNECTICUT

WILLIAM L. SLATE, JR., *Director*

SPRAY BULLETIN

W. E. BRITTON
Entomologist

G. P. CLINTON
Botanist

DIRECTIONS FOR PREPARING INSECTICIDES AND FUNGICIDES.

FORMULAS FOR INSECTICIDES.

LEAD ARSENATE.

3 lbs. (Paste) or 1½ lbs. (Dry) Lead Arsenate and 50 gals. Water.

Spray upon foliage to kill all chewing insects. May be used with ;ordeaux or with lime-sulphur mixture.

PARIS GREEN.

1 lb. Paris Green. 3 lbs. Lime. 100 gals. Water.

Spray upon foliage to kill chewing insects. Commonly used with Bordeaux mixture on potatoes, largely superseded by lead arsenate.

CALCIUM ARSENATE.

1½ lbs. Dry Calcium Arsenate. 1½ lbs. Dry Air-Slaked Lime. 50 gals. Water.

Applied as dust or spray on potatoes. May be used in Bordeaux mixure. Not safe on fruit trees.

POISONED BRAN MASH.

5 lbs. Wheat Bran. 4 ozs. White Arsenic or Paris Green.
1 pint Cheap Molasses. 1 Lemon. 7 pints Water.

Mix to form a dry mash and scatter around field to kill cut-worms, army vorms and grasshoppers.

FRESH HELLEBORE.

Dust on the plants, or mix with water, 1 oz. in 2 gals. and spray. For urrant-worm and other sawfly larvae.

DRY LIME-SULPHUR.

Winter Spray.

12 lbs. dry Lime-Sulphur. 50 gals. Water.

Summer Spray.

3 lbs. Lime-Sulphur. 50 gals. Water.

LIQUID LIME-SULPHUR.

Winter Spray.

1 part Lime-Sulphur. 9 parts Water.

Summer Spray.

1¼ to 1½ parts Lime-Sulphur. 50 parts Water.

Use winter spray for San José scale and peach leaf curl; summer spr: for fungi, to which, as needed, add lead arsenate to kill chewing insec:

CORROSIVE SUBLIMATE.

1 ounce in 10 gals. water, poured around cabbage plants to prevent inju from cabbage root maggot.

DUST MIXTURES.

Sulphur 85%, lead arsenate 15% (or sulphur 90%, lead arsenate 10% is used to dust apple orchards for fungous diseases and chewing insec To kill sucking insects add 2% of nicotine. Copper sulphate 15% to 25 hydrated lime 80%, and calcium arsenate 5% to 25%, is used successful in some localities on vegetables but is likely to russet apples. Plain sulph is used in peach orchards. These dusts can be purchased, mixed rea for use.

LINSEED OIL EMULSION.

1 gal. raw Linseed Oil. 1½ lbs. Soap Flakes. 1 gal. Water.

Dissolve flakes in water; stir in linseed oil and dilute to 100 gals.

NICOTINE SOLUTION.

½ pint of a 40% nicotine sulphate solution in 50 gals. water. Dissol and add 2 lbs. Laundry Soap or 1 lb. Calcium Caseinate for a spreader.

Excellent for killing aphids and other sucking insects.

KEROSENE EMULSION.

2 gals. Kerosene. 1 lb. Common Soap. 1 gal. Water.

Dissolve the soap in hot water, add the kerosene, and churn togeth with pump until a white creamy mass is formed, which thickens on coc ing. Dilute *nine* times before using for most aphids, but may be us stronger or weaker.

MISCIBLE OILS.

Mix 1 part of "Scalecide," "Jarvis Compound," "Target Scale Destroye or other miscible oils with 15 parts of water, to kill San José scale, espe ally on old apple trees.

COMMON LAUNDRY SOAP.

Spray 1 lb. dissolved in 8 gals. water upon foliage to kill red spider, phids, and other sucking insects. Soap flakes may be used in half this uantity.

CARBON DISULPHIDE.

To kill insects infesting stored grain, in tight bins, use 1 lb. for about 00 cubic feet of space. Expose for about 36 hours at 60° F. or higher.

CARBON DISULPHIDE EMULSION.

0 parts (volume) Carbon disulphide. 1 part (volume) Cold water soluble rosin fish oil soap. 3 parts (volume) Water.

Churn the soap and water to obtain an even mixture. Then add carbon lisulphide and churn about two minutes until the mixture emulsifies as dicated by change in color and a creamy liquid is formed. Dilute 200 imes when using and apply one quart per square foot. To kill insects in oil without injuring vegetation.

PARADICHLOROBENZENE.

A granular solid chemical which gives off fumes fatal to insect life. Has recently been used successfully to control the peach borer. Also called 'Krystal gas," "Paradichloride," "P. C. Benzene," etc.

NAPHTHALENE.

Used in the form of moth balls and "flakes" to keep clothes moths out of clothing. "Flakes" scattered around the borders of floors and helves will drive away ants.

CALCIUM CASEINATE SPREADERS.

1-2 lbs. in 100 gals. acts as a spreader and prevents chemical reactions, where different materials are mixed together.

FORMALIN FLY POISON.

1 tablespoonful Commercial Formalin. ½ cup Sweet Milk. ½ cup Water.

Mix and expose in a shallow plate with a slice of bread in it. Flies will drink the liquid, especially if no other moisture is accessible, and be killed.

ANT POISON.

Arsenate Soda 125 grains. Sugar 1 pound. Honey 1 tablespoonful. Water 1 quart.

Add arsenate soda and sugar to water. Boil until both are dissolve then add honey. When cool, place in shallow dishes with a crust of bre or bits of sponge.

HYDROCYANIC ACID GAS.

1 oz. Sodium Cyanide. 2 ozs. Sulphuric Acid. 4 ozs. Water. For each 100 cu. ft. space.

For fumigating dormant nursery stock or buildings, place the acid a water in an earthen jar in the house, drop in the cyanide and close t house at once for half an hour. Ventilate for ten minutes before ente ing. In greenhouse use 1 oz. of cyanide for each 1000 cu. ft. of spac avoid sunlight; excessive moisture; driving winds. Fumigate, betwe 52° and 70° F. Calcium Cyanide in granular form may now be obtain for killing grubs, wireworms and ants in soil; and in form of dust f killing aphids and other sucking insects. Caution! Breathing the fumes w cause death.

FORMULAS FOR COMMON FUNGICIDES.

LIQUID LIME-SULPHUR.

Winter Spray.

1 part Lime-Sulphur. 9 parts Water.

Summer Spray.

1¼ to 1½ parts Lime-Sulphur. 50 parts Water.

Use winter spray for San José scale and peach leaf curl; summer spr for fungi, to which, as needed, add lead arsenate to kill chewing insects

DRY LIME-SULPHUR.

There are now on the market several forms of dry lime-sulphur similar fungicides, that because of convenience in shipping and han ling are replacing somewhat the more bulky liquid fungicides. Wh experience has shown that spray injury does not result from their u they may be substituted for the latter. Use according to directions giv by the manufacturers.

SELF-BOILED LIME-SULPHUR.

8 lbs. Fresh Whitewash Lime. 8 lbs. Fine Sulphur. 50 gals. Water.

Start the lime slaking, sift and thoroughly stir in the sulphur, using just enough water to prevent burning and allow to boil from heat of lime for fifteen minutes. Then dilute and apply.

A very excellent substitute for this fungicide on peaches is the commercial article called "Atomic Sulphur," without lead arsenate, used at the rate of 5 lbs. to 50 gallons water.

DRY MIX.

8 lbs. Sulphur. 4 lbs. Hydrated Lime. 1 lb. Casein Spreader. 50 gals. Water.

Mix thoroughly together the first three ingredients and add to the water when needed. This fungicide is being used more and more in this state as a peach spray.

SULPHUR DUST.

Dusting with special grades of very fine sulphur, about 90 parts thoroughly mixed with 10 parts lead arsenate for apples and 80 parts sulphur and 20 parts air-slaked lime for peaches, or with special material prepared by manufacturers, has attained some prominence as a combined fungicidal and insecticidal treatment for fruit trees. Experience so far in this state seems to show that such treatment is much more effective in controlling insects than fungous troubles of the apple. Good results in controlling peach scab and fair results for brown rot have been obtained. Dusting is much quicker and so cheaper as regards labor, but the cost of the material used is considerably greater.

COPPER DUSTS.

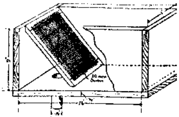
There are now on the market certain commercial dusts containing lime and copper sulphate that combine to form a Bordeaux mixture when in contact with moisture on the leaves. These are coming somewhat into use for certain diseases where dusts can be used to better advantage, so far as mechanical application is concerned, than can Bordeaux mixture. They have been used in this state with more or less success on apples, potatoes and especially on celery. On apples russeting, as with Bordeaux mixture, is likely to result.

BORDEAUX MIXTURE.

4-5 lbs. Copper Sulphate (Blue Vitriol). 5-6 lbs. Fresh Lime. 50 gals. Water.

For small acreage. Dissolve the copper sulphate in hot water. Slake the lime and strain through coarse cheese-cloth. Dilute each separately 25 gallons. Pour together slowly through a strainer into the spray bar

For large acreage. Make stock solutions of copper sulphate and li as follows: Dissolve 40-50 pounds of copper sulphate in 50 gallons of wa by suspending in a bran sack. One gallon of stock solution thus contains ab one pound of copper sulphate. Slake 50-60 pounds of lime, strain inte barrel and make up to 50 gallons. A gallon of this solution contains at le one pound of lime. The excess takes care of waste in slaking. Put t 50-gallon dilution barrels on a platform so that the sprayer can backed under them. For a 100-gallon sprayer put 10 gallons of st lime mixture into the lime barrel and 10 gallons of stock copper sulph solution into the copper sulphate barrel. Dilute each to 50 gallons. By using a molasses spigot for each barrel, the two streams may be run together through a trough into the sprayer. A large, fine wire strainer should be set in the sprayer opening. Lead arsenate, Paris green, or nicotine solution may be added if needed. Hydrated lime is handy to use, but Bordeaux made with it is said by some not to adhere so well and to be more likely to injure apple foliage.



TYPE OF STRAINER RECOMMENDED FOR SPRAY MATERIALS

Some growers get good results with the following method: Start filli the sprayer with water, washing in at same time 10 gallons of the st lime mixture through the strainer. When half full, add the 10 gallons stock copper sulphate solution with the remaining water, stirring meanwh When short handed, this method saves time. Half these amounts are us for a 50-gallon sprayer.

FORMALIN.

A. 1 pt. (1 lb.) formalin in 50 gals. water, for sprinkling grain to l smut. See Smut under Oats. Wet sprinkle. Or better:

B. 1 pt. undiluted formalin is *sprayed* directly on 50 bushels of gr as it is shoveled over and then heaped in a pile and covered for four hou Dry sprinkle.

C. 1 pt. formalin in 30 gals. water; soak uncut tubers 1 hour to prev potato scab.

D. 1 pt. formalin in 12½ gals. water, for soil treatment. Use one-h to 1 gal. for each square foot of surface treated; cover for 24 hours aft treatment; air afterwards and stir soil; allow 7-10 days before seeding a 10-14 days before transplanting in this soil.

CORROSIVE SUBLIMATE.

4 ozs. Corrosive Sublimate. 30 gallons Water.

Dissolve the corrosive sublimate in a small amount of *hot* water and en dilute. Soak uncut seed potatoes in this for ½ to 1 hour. After ch treatment renew strength by adding *1 oz.* of *corrosive sublimate and* iter as needed to retain the 30 gallons. Use in wooden containers and ark *Poison*. Good for both scab and black scurf.

FORMULAS FOR LESS-USED FUNGICIDES.

•OTHER BORDEAUX MIXTURES.

Dilute Bordeaux Mixture. Use 1 lb. copper sulphate, 4 of lime, and ake as above directed. For second and third sprayings of apples to ssen russeting of the fruit.

Resin Bordeaux Mixture. Melt 5 lbs. resin with 1 pt. fish oil, cool slightly, ld 1 lb. soda lye, stirring. Add 5 gals. water and boil till the mixture ill dissolve in cold water. *Mix 2 gals.* with 48 of Bordeaux *mixture.* sed sometimes on such glaucous plants as asparagus, cabbage, onions, etc., make a more adhesive spray.

SPREADERS.

Certain commercial forms of casein are now on the market and can b used in Bordeaux mixture as a spreader instead of the preceding.

COPPER SULPHATE.

2 to 3 lbs. Copper Sulphate. 45-50 gals. Water.

Used chiefly as a winter spray. 1 lb. to 250 gals. water is sometime though rarely used on foliage.

POTASSIUM SULPHIDE.

3 ozs. Potassium Sulphide. 10 gals. Water.

Used chiefly in greenhouses, or for powdery mildews.

FORMALIN FUMES.

3 pts. Formalin. 23 ozs. Potassium Permanganate.
For each 1000 cu. ft. Space.

Place bulbs or tubers in 6 to 12 in. crates so fumes can get at then To prevent injury to potatoes, *fill* space at rate of *167 bu.* Place formali in large pail in cleared central space and drop in the crystals of potassiu permanganate. Close room air-tight for 24 to 48 hours.

INSECTS AND THEIR INJURIES TO PLANTS.

Insects are small animals belonging to the class Hexapoda (six-legged) and most of them have six legs in some stage of their existence. Spiders, mites, sow bugs, centipedes and millipedes are animals but not insects and all but certain mites have more than six legs. Insects may be divided roughly into two groups: (1) chewing or biting insects, and (2) sucking insects. The chewing insects (except termites or white ants, and grasshoppers and crickets) have four distinct stages in their life cycles, as follows: (1) egg, (2) caterpillar, grub or larva, (3) pupa, (4) adult insect. Such insects are said to have complete transformations. The exceptions noted above and the sucking insects do not pass through these four well-marked stages. There is usually, though not always, an egg stage, and an adult stage, but there is no pupa (except in case of the males in certain species of scale insects and white flies) and the larvae are called nymphs after hatching from the eggs, and undergo a gradual development, molting several times with only slight changes until the adult stage is reached.

Chewing or biting insects have strong jaws or mandibles with which they bite or tear off bits of food like the higher animals. Such insects swallow their food and here is where an arsenical poison can be employed with success. This class includes all caterpillars, beetles, sawflies, grasshoppers and crickets.

Sucking insects puncture the tissues with their beaks or probosces and suck out the sap for food. Such insects car be killed by applying arsenical poisons to plants but mus treated witb dusts or contact sprays which will suffocate tl and corrode their tissues. Aphids, scale insects, leafhop and all plant bugs belong to this class.

Never Spray Fruit Trees When in Bloom. The applica of lead arsenate or other arsenical poisons to trees in blos may do much harm (1) by injuring the essential organs of flowers, so that fruit will not set, and (2) by killing man the bees which carry pollen from one tree to another. If honey bees and native wild bees were killed, there would little or no set of fruit.

Spraying Versus Dusting. Six years' experiments in C necticut show that in apple orchards, spraying gives a lar percentage of good fruit than dusting and is less expens Dusting gives fairly good control of insect pests but does hold fungous diseases in check like spraying. Dusting given as good results as spraying in controlling scab brown rot on peaches. It is probable that dusts can be u to advantage on low growing vegetable crops, where spray is impracticable.

Safe Combinations of Sprays. It is safe to mix lead arsen with lime-sulphur, Bordeaux and nicotine, but none of th should be combined with miscible or other oils. It is a unsafe to use soap with lead arsenate.

.epeat two weeks after blossoms fall. Destruction of early rops before July 1, from apple and neighboring peach, plum nd cherry trees is important. Remove infested fruit in thinning. Keep fence rows clear of trash. Rept. 1904, p. 219.

Apple and Thorn Skeletonizer—Small spotted larvae feeding n web skeletonize upper surface of leaves. White pointed ocoons formed on leaves. Purplish moths fly about and rest n flowers. Three broods each season. Unsprayed apple rees brown in June and August. Spray with lead arsenate niddle of May, first of July and middle of August. Rept. 920, p. 190; 1921, p. 186; Bull. 246.

Green Fruit Worms: Palmer Worm: Leaf Roller—Caterillars all feed upon foliage and immature fruit. Spray with ead arsenate, as for codling-moth.

Tussock Moths—Tufted caterpillars of several species feed ipon the leaves in mid-summer. Spray with lead arsenate as or codling-moth. Rept. 1905, p. 230; 1907, p. 332; 1916,). 105; 1917, p. 325.

Yellow-necked Caterpillar: Red-humped Caterpillar—Feed n clusters and often strip young trees in fall. Hand-picking is easy method of control. Spray leaves with lead arsenate. Rept. 1901, p. 274; 1917, pp. 328, 329.

Maggot or **Railroad Worm**—Maggots tunnel through the pulp of the ripening fruit of sweet and sub-acid varieties, especially those ripening early in the season. Destroy all infested fruit. Spray as late as July 15 with lead arsenate to kill adult flies. Rept. 1910, p. 593.

Round-Headed Borer: Flat-Headed Borer—Grubs burrow in wood at base of trunks. Watch trees and dig out borers wherever sawdust appears. Paint trunk with lead arsenate and lime-sulphur. Rept. 1907, p. 333.

Leafhoppers—Whitish insects sucking sap from under sid the leaves. Spray with nicotine solution, as for aphids.

Tarnished Plant Bug—Injures developing fruit by suckin sap, forming dimples. Spray or dust with nicotine as fc aphids.

Red Spider: Clover Mite: European Red Mite—Caus much injury to leaves, especially in dry seasons. Overwinte ing eggs killed by spray of miscible oils about April 15 Spray in May and June with lime-sulphu or strong soaps.

Leaf-Blister Mite—See Pear.

Green and **Rosy Aphids**—Green aphic suck sap from the leaves and termin shoots, causing leaves to curl and checkir growth. Rosy aphids infest fruit cluster checking development. Use delayed dc mant spray with nicotine solution (½ pi in 50 gallons water), either separately with lead arsenate, lime-sulphur or Bordeau mixture. Dust with nicotine. Repts. 19c p. 259; 1909, p. 343.

San José Scale—See Peach. Spray dormant trees with lim sulphur or miscible oil. Bull. 165; Rept. 1904, p. 221.

Red Bugs—Two species of red leaf bu suck the sap, causing leaves and fruit become distorted. Spray with nicotine so tion, as for aphids, or dust with 2% nicotii Rept. 1917, pls. II-III.

Woolly Apple Aphis—A bluish-whi cottony plant louse in colonies on ba forming galls or swellings on twigs of sm trees, and preventing wounds from healir also on roots, forming galls, and destroyi

small feeding roots. Plant only clean or fumigated stock. Soak soil with carbon disulphide, ½ ounce in 4 gals. water. Spray above ground with kerosene emulsion.

Oyster-Shell Scale: Scurfy Scale—Scale insects with elongated or pear-shaped shells, on bark, suck sap from the twigs; the former about the same color as the bark, the latter light gray or whitish. Spray with nicotine solution; soap and water; or kerosene emulsion, about the second week in June. Bull. 143; Rept. 1903, p. 225.

Fungi, etc.

Baldwin Spot—Shows as small diseased masses of brownish tissue, usually a short distance beneath the skin; finally may appear at the surface as small, discolored, shrunken areas, then very similar in appearance to some of the fruit speck troubles. Not a fungous disease. Thought by some to be due to unusual local loss of water; similar troubles may start from punctures of rosy aphids or other puncturing insects. No definite remedy known; spray to keep down sucking insects.

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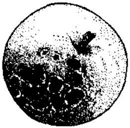
Cankers—Occur on branches and are caused chiefly by European canker fungus which eventually forms a cavity surrounded by concentric elevated rings of wood extending to bark. Cut off infected branches, or cut out infected wood and bark; paint over cut surfaces. Keep orchard well sprayed and trimmed. Rept. 1903, p. 299.

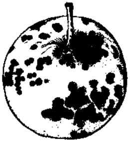
Black Rot—Causes mature fruit to turn brown, then black; forms small brown spots on leaves; does some damage through cankers on branches, which are eventually killed. Treat as for scab; prune burn all dead limbs and twigs; cut out and paint over la cankers when found. Rept. 1909-10, p. 590.

Fruit Specks—Appear as more or less numerous, sm brown or black spots, starting at surface of fruit and slo working inward; the Brooks fruit spot often has a pink border in light-skinned varieties. Usually controlled by late sprayings in June and July. Rept. 1909-10, p. 590.

Rust—Shows as orange-colored blotches on leaves, even ally producing minute fringed clustered cups imbedded on under side; less frequent on fruit. Rust spreads to the ap from the **cedar-apples,** which appear in the early spring on red cedar. All cedars near the orchard should be destroy There is great difference in the susceptibility of differ varieties to this disease. Spraying is only partially succes in this state. Repts. 1891, p. 161; 1909-10, p. 591.



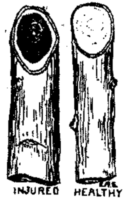
Scab—Produces "scabby spots" on f and leaves; rarely on twigs. Give the p pink and pink sprays before the blosso open, another after the petals fall, and foll with one, two, or more, at intervals of th weeks. For first treatment, use strong B deaux, for others, weak Bordeaux or li sulphur or better still the latter for all tre ments. Rept. 1909-10, p. 591.



Sooty Blotch—Forms on fruit an oli black superficial growth in distinct rou colonies, often merging together. Spray for scab, with lime-sulphur, 1½ to 50. T sprayings after blossoming, as for the fr specks, are the more important. Rept. 19 10, p. 592; 1911, p. 367.

Blight—See Pear. Not so serious on apple in this state as on pear. Doubtful if control measures for apple are practical here in most cases.

Spray Injury—Takes the form usually of burn on leaves and russeting on fruit. Is most likely to occur after later sprayings. Worst in wet seasons with Bordeaux and in warm seasons with lime-sulphur. Drenching the trees with high pressure apparatus is apt to produce injury. Spraying in bright sunshine may cause some scorch on fruit on sunny side. Varies greatly with different sprays. Avoid those known to be injurious or injurious combinations (as soap and lead arsenate); use Bordeaux if at all only for **first** summer treatment or on varieties not especially subject to russeting. Liquid or dry lime-sulphur is now the fungicide most commonly used on apples in this state. Rept. 1911, p. 360.



Winter Injury—Takes various forms from different conditions, sucb as: imperfect fertilization or russeting of fruit following late spring frosts; sun scorch of trunks due to mild winter weather followed by sudden cold; bud and twig killing, frost cracks in trunks, blackened wood, dead roots, etc., following unusually cold winters or unfavorable environment. Set out only hardy varieties; avoid planting in wet ground or on hillsides with extreme south or southwest slopes. Head trees low; avoid late fertilization and cultivation; keep earth tight around trunks; use cover crops. Repts. 1903, p. 303; 1906, p. 310; 1914, p. 6.

Storage Rots—Are troubles caused by a variety of fur Store fruit, in a dry condition, in a cool, well-aired place. not store in too deep piles or too tight receptacles. Use poo keeping varieties first, and sort over if necessary. App from well sprayed trees keep best. Rept. 1915, p. 426.

General Treatment for Apple Orchards.

For the general control of fungi and insects on apples Connecticut we make the following recommendations:

(1) Dormant (winter) treatment is necessary in the pi ence of red mite, San José scale and leaf blister mite. l liquid lime-sulphur 1-9, or miscible oil 1-15; the latte necessary for red mite control. The lime-sulphur is best u just as the leaves begin to show ("Delayed Dormant") a then kills many aphids and may lessen scab infection. Mi ble oil must not be applied later than when buds begir swell or injury will result.

(2) Make at least three summer treatments with a fungi and insecticide as follows:—

1. Pink spray, when blossom buds show pink.
2. Calyx spray when petals fall.
3. Young fruit spray three to four weeks later.

For scab control a pre-pink treatment is necessary tc applied between delayed dormant and pink. For contrc sooty blotch, Brooks' fruit spot and often scab an additi treatment three to four weeks after No. 3 is required. treatment is also necessary to control apple maggot, late ling moth and green fruit worms. The calyx spray is most important to control codling moth.

(3) For a fungicide we recommend liquid lime-sulphur at the rate of 1¼ to 1½ gallons to 50 gallons of water, or dry lime-sulphur at the rate of 3 lbs. to 50 gallons of water, for all summer treatments. In case of severe scab infection Bordeaux mixture 1-4-50 may be used at the pre-pink and pink sprays without much danger of injury to the fruit but this practice is not in general use. In case one desires to dust, a sulphur dust is preferable to a copper dust.

(4) For the insecticide in the above, use lead arsenate, if in the paste form at the rate of three pounds per fifty gallons of the mixture, or if in the powder form one and one-half pounds per fifty gallons.

(5) If canker worms, tent-caterpillars, bud moths or brown-tail moths are causing damage, add lead arsenate to the first summer treatment; if not it may be omitted but should be included in each of the later treatments. Nicotine solution may be added to the pre-pink treatment for aphids and to any of the subsequent treatments to destroy aphids, red bugs, tarnished plant bugs, etc.

ARBOR-VITAE.

Insects.

Leaf-miner—The larva of a small moth mines the leaves causing them to turn brown. Spray heavily with nicotine sulphate solution the first week in June to kill adults and their eggs. Rept. 1921, p. 157.

Fungi, etc.

Browning—Shows especially through the older inner leaves turning brown and falling prematurely in late summer or fall. As there often remain only the leaves of the current year's growth the tree eventually presents a scanty healthy foliage; the brown leaves before they drop give the appearance serious fungous disease. Due to dry summers followe some cases by winter injury. Not a progressive trouble so finally not usually serious.

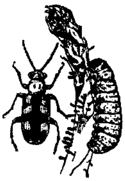
ASH.

Fungi.

Anthracnose—Causes large brown areas to appear sudd in late spring or early summer on the leaves which may wither up much as if sun scorched. Usually infrequent feared, spray as for anthracnose of sycamore.

Rust—Occurs commonly on blades and petioles of lea and less frequently on the green twigs and fruit, as s cluster-cups filled with orange spores. The plant tissues often swollen and distorted. Variable in its occurrence, so times prominent and wide-spread and the next year or possibly infrequent or absent. Said to spread to ash f other spore stage on marsh grass. No efficient cor methods, but causes little permanent injury to the trees.

ASPARAGUS.



Insects.

Asparagus Beetles, Common and 12-s ted—Adults and larvae devour the foli Cut everything clean during the cutting son; afterward spray with lead arsenate calcium caseinate. Rept. 1921, p. 171.

Asparagus Miner—Larvae tunnel u epidermis of stem near base, causing pre ture death of plant above ground. Burr fested stalks. Rept. 1906, p. 303.

Fungi, etc.

Frost Rot—Shows as rotting shoots here and there in the field, which have been previously injured by severe late frosts. Nothing need be done as the trouble is not progressive despite the presence of fungi causing the final decay.

Rust—Produces small reddish or black elongated pustules scattered over stems. In fall, carefully gather and burn all stems from affected beds and escaped plants in vicinity. In gathering for market cut below the ground, as protruding stems offer opportunity for development of first stage of the fungus. Spraying with resin Bordeaux partially controls the disease, but is seldom practiced now. Begin spraying the latter part of July and repeat about every 10 days until the middle of September. Thorough cultivation and fertilization, with plenty of humus in the soil, are advocated as beneficial. Grow varieties most resistant to the disease. This disease is not so serious as it was some years ago partly because more resistant varieties are now grown. Repts. 1896, p. 281; 1904, p. 313.

ASTER.

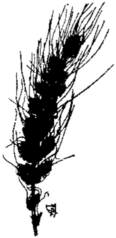
Insects.

Blister Beetles—Three or four species feed upon the flowers, the black one being commonest. Hand-pick and cover choice plants with mosquito netting. Bull. 208, p. 110.

Fungi, etc.

Yellows—Shows in the yellowed and often imperfectly developed foliage and one-sided blossoms. A physiological trouble; the cause not definitely known. Buy best seed; transplant only healt plants; have soil conditions good; keep down leafhoppe Repts. 1903, p. 306; 1914, p. 413 (26).

BARLEY.



Insects.

Army Worm—See Grass.

Fungi.

Rusts—See Oats and Wheat.

Smuts—Are of two kinds, covered a loose, both largely destroying the infec spikes and changing them into black, soo structures, in the latter kind easily dis pated. Treatment, see Oats. Rept. 19 p. 306.

BEAN.

Insects.

Green Clover Worm—Occasionally green, wriggling cat pillars riddle the leaves in June and July. Dust string be with air-slaked lime or other fine powder. Spray shell be with lead arsenate. Repts. 1908, p. 828; 1919, p. 165.

Weevils—Adults lay eggs in the pods in field and continue to breed in the dried se finally rendering it unfit for food or for planti Fumigate the seed with carbon disulphide as s as harvested, store in air-slaked lime, or hea oven for 1 hour between 120° and 150° F. E 105, p. 6.

Fungi, etc.

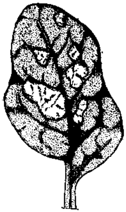
Anthracnose—Shows on leaves and pods as roundish discolored areas, often with a purplish border. Save seed from pods showing no spots and plant these by themselves, selecting each year seed from unspotted pods for the seed crop and using remainder for general crop. Destroy all infected seedlings. Where very troublesome spray with Bordeaux, beginning when plants are only a few inches high and repeating about every 10 to 14 days until pods are formed. Rotation and destruction of old vines may prove helpful in keeping the trouble in check.

Blight—Appears much like anthracnose, but with discolored areas having more of a translucent or watery character. Treat same as for anthracnose. Repts. 1898, p. 262; 1903, p. 307.

Downy Mildew—Forms dense, white, woolly growths on pods and less luxuriantly on young stems and leaves of the Lima bean. Serious only in years unusually moist after the middle of July. Plant on well-drained soil. Spray with Bordeaux beginning about the middle of July, and repeat every 10 to 14 days until the middle of September. Rept. 1905, p. 278.

Rust—Produces small, round, reddish or black, dusty outbreaks, usually on the leaves. Plant varieties not likely to rust. Burn the old infected plants in the fall, or rotate. Rept. 1903, p. 308.

BEET-CHARD.



Insects.

Leaf-Miner—A small fly lays eggs in leaves, and the larvae tunnel or mine tween upper and lower surfaces. Prac clean cultivation. Destroy all infe leaves. Destroy all plants of the w known as "lambs quarters" in which insect breeds. Practice late fall plowin

Fungi.

Leaf Blight—See Mangel. Rept. 1903, p.

BEGONIA.

Eelworms.

Leaf-Blight Eelworm—Produces spicuous dead areas on the leaves of gonias (especially var. *Cincinnati*), fe etc. Spots vary in size and shape acc ing to host and disposition of larger ve Buy healthy stock only; keep infe plants by themselves and give them ple of room; keep leaves as dry as possible and pick off and b worst infected. Rept. 1915, p. 455.

BIRCH.

Insects.

Tussock Moths—See Apple, Hickory, and Horse Chest

Birch Leaf-Skeletonizer or **Birch Bucculatrix**—Small gre ish-yellow larvae feed upon both sides of the leaves in summer, often entirely defoliating the trees. Spray with l arsenate (about August 1). Rept. 1910, p. 701.

Birch Leaf-miner—Sawfly larvae mine the terminal lea of gray birch causing them to turn brown. There are th annual generations and a partial fourth, in Connecticut. C trol not investigated. Rept. 1924, p. 340.

Bronze Birch Borer—Grub makes spiral tunnel just beneath bark of upper main branches, ridges showing on outside. Cut and burn infested trees before May 1. Spray foliage with lead arsenate about June 1, and fertilize and water the trees. Rept. 1922, p. 359.

BLACKBERRY.

Insects.

Blackberry Crown Borer—Larva tunnels in roots and at base of stem. Dig out and destroy.

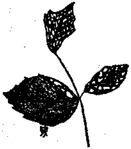
Red-Necked Cane Borer—Larva tunnels in canes causing an irregular swelling or gall, often three inches in length. Cut and burn all infested canes in winter or early spring.

Blackberry Sawfly—Larvae devour leaves in June and first part of July. Spray with lead arsenate when young larvae appear. Rept. 1912, p. 236.

Fungi, etc.

Crown Gall—Forms hard galls or irregular excrescences on roots and lower parts of stem. Dig out and burn affected plants as soon as discovered. Never use infected stock for transplanting. A bacterial trouble. Rept. 1903, p. 354.

Leaf Spot—Shows on leaves as small circular spots with whitish center and purplish border; also occurs on dewberry and raspberry. Not usually serious, but where necessary it can be controlled by Bordeaux applied to the leaves, beginning before they have reached their full size. Rept. 1903, p. 309.



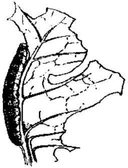
Orange Rust—Breaks out in spring or early summer as dusty masses of bright orange spores over the under side of the leaves. The fungus is perennial in the underground parts. Dig up and burn infected plants. Rept. 1903, p. 309.

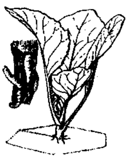
BOX.

Insects.

Leaf-Miner A small two-winged fly lays eggs in the l and the larvae tunnel between the upper and lower surfac Destroy infested leaves. Spray under side leaves with molasses, 1 part in 3 parts wa

Oyster-Shell Scale—See Apple.





CABBAGE-CAULIFLOWER.

Insects.

Cabbage Worm—Green worms feed u leaves all through season. Spray or d unheaded plants with lead arsenate us calcium caseinate in the spray. Use ins powder or hellebore on headed plants. E 190, p. 9; Rept. 1903, p. 271.

Cabbage Looper—Smooth looping ca pillars feed with cabbage worms late summer, and require same treatment. I 190, p. 12; Rept. 1910, p. 706.

Cabbage Aphis—Sucks sap from leaves. Make heavy applications of r tine dust. Bull. 190, p. 14; Rept. 1 p. 319.

Cabbage Maggot—Infests stems of ea set plants near surface of ground, chec growth and often killing them. Pra crop rotations. Place hexagonal tarred p disks around stems at setting time. T with carbolic acid emulsion or with co sive sublimate. Bull. 190, p. 3; Repts. p. 832; 1914, p. 142; 1915, p. 114.

Fungi, etc.

Bacterial Leaf Spot—Shows as small, blackish, angular spots or specks on the leaves especially of the cauliflower. When abundant causes yellowing and premature death of the infected leaves. Watch the seed beds for signs of infection. If prominent in the field, next year treat the seed (see Black Rot) and spray the seedlings with Bordeaux mixture.

Black Leg—Causes cankered and finally black areas especially at base of the stem of young plants which later in the field often rot off or fail to make heads. Select only apparently healthy seedlings for transplanting and if this fails treat as for Black Rot another year.

Black (Bacterial) Rot—Forms black lines in veins of leaves. In time leaves turn yellow and easily drop off, and interior of head develops a general soft rot. As the germs can be carried on the seed, avoid seed from infected fields. If in doubt, treat seed in formalin, 1 part to 240 of water for 15 minutes. Keep refuse from diseased plants out of manure; practice rotation; make seed bed in new soil if disease appears in old one. Rept. 1912, p. 345.

Club Root—Causes knob-like enlargements on the roots of cabbage and allied plants. The germ often becomes established in the soil; avoid such land and the use of refuse from old plants on the soil. Be especially careful that the seed bed is not infected. Infected land, if used, should be treated in the fall with lime broadcast at the rate of 80 busl per acre and worked in. Rept. 1903, p. 310.

Soft Rot—See Salsify. Rept. 1903, p. 311.

CARNATION.

Insects.

Green Fly or **Aphis**—Sucks sap from young leaves buds. Fumigate greenhouse with tobacco, or spray with n tine solution and soap, or with soap and water.

Fungi.

Leaf Mold and **Leaf Spot**—Are two troubles much alik appearance, producing grayish spots with colored borders stem, leaves and calyx. Treat as for Rust.

Rust—Produces small dusty pustules, more or less con ent, on the leaves and stems. Select rust-resisting variet Spray in field with Bordeaux, adding spreader. Select transplanting only hardy and rust-free specimens. Keep ai greenhouse dry. Give one or two sprayings with Bordea after transplanting in greenhouse; for repeated sprayings potassium sulphide or weak copper sulphate. Rept. 1903 312.

Stem Rot and **Wilt**—Cause the lower leaves first to t yellow and dry up; then the stem gradually rots off at base. Select cuttings only from perfectly healthy plants, start these in sterilized soil and replant out of doors in r land, avoiding excessive use of manure. If disease appe after setting out in the greenhouse, pull up infected pla upon appearance of first symptoms, make liberal applicatior lime, avoid over-watering, and see that roots are prope aerated. Repts. 1897, p. 175; 1903, p. 312.

bark of up
and burn in
lead arsenate
Rept. 1922, p. 3

Insects.

Blackbe
base of
Pies

CEDAR.

—Small brown caterpillars feed upon the leaves b together. Spray with lead arsenate.

pple Rust—Appears in spring as conspicuous round- with jelly-like horns bearing spores that carry the to apple and related hosts. Cut off and burn all *cedar-* if undesirable to destroy the trees. See Apple Rust.

CELERY.

Insects.

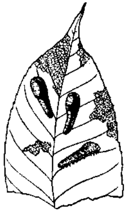
Celery Caterpillar—Feeds upon the leaves of celery, parsley, fennel, carrot and parsnip. On the latter two plants lead arsenate may be used. On celery and parsley hand picking is perhaps the best remedy. Rept. 1920, p. 204.

Fungi, etc.

Early and Late Blight—Two diseases showing "rusty" spots on leaves; the latter trouble distinguished by the very minute black dots in the discolored spots (fig.) and often progressing in stalks after storage. Spray the plants thoroughly in the seed bed with Bordeaux, as infected plants are a means of introducing the trouble in the field. Continue the spraying after transplanting at intervals of about two weeks up to the last of September. Some use copper dust instead of the spray. Before covering for bleaching, if leaf spot is abundant give final treatment. Rept. 1897, p. 167.

Soft (Heart) Rot—Shows as a soft rot of the tissues o confined to the heart. Do not plant in too wet soil; avoid l with green cover crops recently plowed in; in banking al for proper aeration. See Salsify. Rept. 1914, p. 10.

CHERRY.



Insects.

Cherry or **Pear Slug**—Larvae eat a the green tissue from upper side of l Spray or dust with lead arsenate and phur. Rept. 1920, p. 199.

Canker-Worms—See Apple.

Cherry Maggots or **Fruit Flies**—Larva two species infest maturing fruit. Spri foliage with sweetened lead arsenate in e June to kill the adult flies.

Plum Curculio—See Plum.

Cherry Aphid—A brown aphid which sucks sap from u side of leaves, causing them to curl. Spray with nicotine s tion and soap, soap and water, or kerosene emulsion.

Fungi.

Black Knot—Forms knot-like growths on t and branches. Plant only trees free from trouble; in the orchard, cut off and burn all infe branches in late fall or winter, painting over l cut surfaces. Cutting *out* knots is not advisabl new outbreaks usually result. In cutting off, several inches below the knot, to insure remov diseased tissues. Remove all knots each year they fail to reappear. Spraying in spring and e summer with self-boiled lime-sulphur or Atomic phur helps to keep new knots from fruiting, b

entirely secondary in importance to the removal of the knots. Rept. 1911, p. 399.

Brown Rot—See Plum. Rept. 1911, p. 402.

Anthracnose—Shows as numerous, closely placed, purplish spots on leaves, which often have "shotholes." Spraying, if begun on young leaves early in May, is effective. Use self-boiled lime-sulphur or Atomic Sulphur. Give four or five sprayings at intervals of two weeks. Repts. 1895, p. 188; 1911, p. 401.

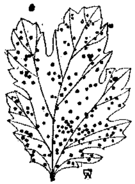
Powdery Mildew—Develops a cobweb-like growth over the leaves. Usually worst in young trees; controlled by spraying.

CHRYSANTHEMUM.

Insects.

Black Fly or **Aphis**—Sucks the juice from the young leaves and flower stems. Fumigate the house with tobacco; dip the plants in or spray them with soap and water or nicotine solution and soap.

Gall Midge—Larvae form cone-shaped galls on leaves and new shoots. Spray plants about three times each week with nicotine solution and soap. Rept. 1919, p. 161.



Leaf Mite—See Cyclamen.

Fungi.

Powdery Mildew—Develops as a white mealy or cobweb coating on leaves. Air and water carefully, and if necessary spray from time to time with potassium sulphide or paint heating pipes with sulphur.

Rust—Appears as dusty reddish-brown outbreaks, about the size of a pin head, chiefly on under sides of leaves. Avoid susceptible varieties. Start with cuttings free from rust. Destroy rusted leaves, especially on y plants. Early sprayings with dilute copper sulphate or p sium sulphide may help to prevent the trouble from gett start. Rept. 1903, p. 315.

CINERARIA.

Insects.

Aphis or **Green Fly**—Sucks sap from the leaves and s Use nicotine solution and soap, or soap and water, as a s or dip.

CLOVERS.

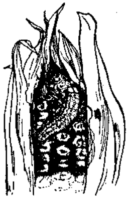
Insects.

Aphids—See Alfalfa.

Fungi.

Powdery Mildew—Appears as a white, somewhat pow coating over the leaves, especially of red clover, in its sun spore stage only. Recently a wide-spread disease over ea United States. While common in this state usually not se as it appears most frequently on escaped plants or secon growth. As yet no practical control measures.

CORN.



Insects.

Cut-Worms—See Tomato.

Army Worm—See Grass.

Stalk Borer—See Dahlia.

White Grubs—See Grass.

Corn Ear Worm—Eats the immature nels at the end of the ear. Dust the with equal parts sulphur and powdered arsenate. Rept. 1921, p. 165.

European Corn Borer—Imported eastern Massachusetts, New York and ada and has been found at a few points a

the Connecticut coast. *Clean-up measures taken.* Larvae tunnel in all parts of plant above ground. Destroy all infested plants. Send suspected material to Station. Repts. 1918, p. 316; 1923, p. 277.

Fungi.

Leaf Blight—Kills parts of the leaves in August and September much like an early frost. Most injurious in wet late seasons. Plant early maturing varieties and stimulate growth by good fertilization and cultivation. Rept. 1903, p. 317.

Root and Ear Rots—Injure roots and base of stalk with a reddish-brown rot. Stalks are easily broken off and often fail to produce ears. The ears show moldy, white or pinkish growths. Plant only vigorous disease-free seed, practice yearly rotation and do not let corn follow other grains. Bull. 222, p. 427.

Smut—Forms black dusty outbreaks on various parts of the plant. It is especially injurious to certain varieties of sweet corn. Seed treatment is ineffective.

CRANBERRY.

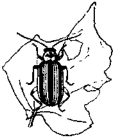
Insects.

Fireworm or Black-headed Cranberry Worm—Small, pale green, black-headed caterpillars web the leaves and new shoots together and feed inside the nest. Spray with lead arsenate to kill the caterpillars. Flood the bog for three days to kill the pupae.

Yellow-headed Cranberry Worm—Small, green yellow-headed caterpillars injure plants in same manner as the preceding. Spray with lead arsenate. Keep bogs flooded until

Cranberry Fruit Worm—Pale green larvae *infest the b*ries. Flood the bog for about two weeks as soon as the fr has been harvested. Destroy all infested berries.

CUCUMBERS.



Insects.

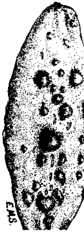
Striped Cucumber Beetle—Attacks you plants, eating the leaves. Larvae infest t main root or stem under ground, often killi the plant. Dust leaves with dry lead arsena Cover plants with screens. Bull. 216, p. Rept. 1908, p. 807.

Melon Aphid—See Melon.

Fungi, etc.

Anthracnose—Produces prominent discolored spots, more less merged, on leaves; occurs as rot on fruit. More seri on watermelon. Treatment is the same as for mildew.

Downy Mildew—Forms discolored spots as in precedi with fungous growth on lower side. Repeated sprayings w Bordeaux every 10 to 14 days during the season, beginning least by middle of July, usually keeps t disease in check. Rept. 1904, p. 329.



Mosaic and **White Pickle**—Are two v similar, if not identical, physiological disea showing in the former on the leaves as m *tling of lighter or yellow-green areas* scatte among the normally green tissues, and in latter causing the fruit to become irregul shaped, knobbed, and often mottled or whi in color. Keep down sucking insects that n spread the disease, as it is infectious; pull and destroy vines first showing it. Rept. 1 p. 430.

Currant Fruit Fly—Small maggots infest the berries, which color prematurely and drop. Destroy infested fruit.

Currant-Worm—Devours foliage in May. Spray with hellebore or lead arsenate. Rept. 1902, p. 170.

Currant Borers—The larvae of two species of insects tunnel in the pith of the stems, causing the leaves to droop and wilt. Destroy infested canes during May.

Currant Stem Girdler—Adults cut or girdle tip of new shoots after laying eggs in them. Cut and burn these tips at any time of year. Rept. 1920, p. 201.

Currant Aphids—Yellowish-green aphids on under side of leaves, causing them to curl. Underspray with nicotine solution or kerosene emulsion, or apply nicotine dust.

Four-Lined Leaf-Bug—A yellow and black striped bug sucking sap from the leaves. Spray with nicotine solution and soap. Bull. 208, p. 118.

San José Scale—See Peach.

Scurfy Scale—A conspicuous pear-shaped light-gray scale on bark, the insect sucking sap from twigs. Spray about second week in June with kerosene emulsion or nicotine solution and soap. Bull. 143; Rept 1903, p. 227.

Fungi.

Anthracnose and **Leaf Spots**—Cause spots on the leaves and usually their premature shedding; the former also spots the fruit of certain varieties. Spray with Bordeaux as the leaves unfold, and repeat at intervals of 10 to 14 days until the fruit begins to ripen. If necessary continue spraying after harvest. Rake up and burn leaves in fall.

about size of pinhead on lower surface of leaves, and l as short hair-like growths. Worst on black currants w should be destroyed, if infected, near white pines, the alter host. Report presence to the Experiment Station. See I Rept. 1911-12, p. 347.

CYCLAMEN.

Insects.

Leaf-Mite—Transparent microscopic mites cause leave curl, and plants do not blossom. Syringe under leaf sur strongly with water. Spray with, or dip plants in, nico solution and soap, 1 part in 400 parts of water. Avoid ex sive moisture in house. Rept. 1914, p. 176.

DAHLIA.

Insects.

Tarnished Plant Bug—Sucks the sap from stems and buds causing them to fall. Spray v nicotine solution and soap. Rept. 1904, p. 218.

Stalk Borer—Larva tunnels up and down ins the main stem, the top portion usually wilting : dying. Carefully make longitudinal slit in the st and kill the borer. Bull. 208, p. 111; Rept. 19 p. 180.

EGG-PLANT.

Insects.

Flea Beetle—See Potato.

Colorado Potato Beetle—See Potato.

Fungi.

Fruit Rots—Caused by several fungi, the gray mold prod ing the most extensive rot. Spray with Bordeaux; pick and carry away the rotting fruit.

ELM.

Insects.

Spiny Elm Caterpillar—Clusters of black spiny caterpillars often strip certain branches of elm, willow, and poplar. Remove and destroy entire cluster, or spray with lead arsenate. Rept. 1906, p. 260.

Elm Leaf Beetle—Adult beetles eat holes through the leaves in May, and in June and July the larvae or grubs eat away the green tissues from the under surface. Spray with lead arsenate early in May to kill egg-laying beetles, or spray under surface of leaves with same mixture about June 1, to kill the larvae. Yellow pupae at base of trees may be killed with kerosene emulsion or soap and water. Bull. 155; Rept. 1908, p. 815.

Canker-Worms—See Apple.

White-Marked Tussock Moth—See Horse Chestnut.

Leopard Moth—Larvae tunnel in branches under the bark, cutting deep galleries, often girdling the branch, which later breaks off and falls to the ground. Small trees may be examined and borers killed by injecting carbon disulphide, or by inserting a wire. Bull. 169; Rept. 1911, p. 317.

Elm Scale—A large brown soft scale, oval in shape with cottony marginal fringe, located especially in the cracks of the bark of trunk and lower branches, sucking the sap. Spray with kerosene emulsion. Bull. 151; Rept. 1905, p. 235.

White Elm Scale—A whitish pear-shaped scale on twigs. Spray about June 10 with kerosene emulsion.

Elm Woolly Aphids—Several species curl the leaves, or form in cottony masses on the bark. Spray with kerosene emulsion

Fungi.

Leaf Spot—Shows as black slightly elevated specks more less thickly imbedded in the leaves, causing their prematu fall. Not usually so injurious as to warrant the expense spraying with Bordeaux which should start the young leaves. Rept. 1909-10, p. 717.

EUONYMUS.

Insects.

Euonymus Scale—The various species Euonymus are attacked and often injured this scale, which has narrow white (male) pear-shaped gray or brown (female) shel Cut and burn infested twigs. Cover and fur gate with hydrocyanic acid gas. Spray wi nicotine solution or kerosene emulsion duri June to kill young. Rept. 1921, p. 185.

FERN.

Insects, etc.

Hemispherical Scale—Brown, oval convex scales on fror of plants under glass. Apply soap and water or nicotine so tion as a dip or spray. Bull. 151, p. 9; Rept. 1905, p. 239.

Leaf-Blight Eelworm—See Begonia.

GERANIUM.

Insects.

Greenhouse Leaf-Tyer—Small green wriggling caterpill: feed upon the leaves of plants under glass. Spray with le arsenate.

White Fly—See Tomato.

Leaf Mite—See Cyclamen.

Bacterial Leaf Spot—Shows as light or finally dark brown, semi-pellucid when wet, spots on the leaves, causing their premature death when abundant. Watch the propagating stock and start with disease-free cuttings; destroy first infected leaves; if necessary spray with Bordeaux mixture.

Gray Mold—Produces dead areas on leaves and blasts blossoms. Worst in poorly lighted and leaky greenhouses. Keep drippage off plant; avoid watering in cloudy or muggy weather; ventilate. Attacks as a semi-parasite a variety of greenhouse plants. Rept. 1903, p. 322.

GOOSEBERRY.

Insects.

Currant-Worm—Devours foliage. Apply hellebore or lead arsenate early in season. Rept. 1902, p. 170.

Gooseberry Fruit-Worm—Feeds inside the berry. Destroy infested berries.

Currant Fruit Fly—See Currant.

Fungi.

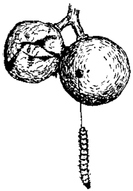
Mildew—Forms a felt-like growth on fruit and leaves of young shoots. Worst on European varieties; also attacks currants, especially young shoots. Spray with potassium sulphide or other sulphur spray as soon as buds break, and repeat about every ten days until the end of June.

Blister Rust—Not common as yet on cultivated varieties. See Currant. The cluster-cup rust is sometimes mistaken for this.

Grape Vine Flea Beetle—Adults and larvae devour leaves. Spray with lead arsenate the latter part of June.

Rose Chafer—Long-legged brown tles appear about June 15 and feed leaves, flowers and newly set fruit, doing great damage. Cover choice p with netting. *Spray heavily with* boiled lime-sulphur just before blos open and again after fruit has set. 1916, p. 111.

Grape Plume Moth—Small green caterpillars web together the n formed leaves at the tips of new shoots. Damage more ap ent than real. Crushing by pinching these leaves is the remedy. Rept. 1914, p. 190.



Grape Berry Moth—Larva feeds and velops inside the berries and is the c of most wormy grapes. Spray with arsenate soon after the fruit sets, and re twice at intervals of about ten days. the clusters soon after the fruit sets. 1920, p. 206.

Grape Root Worm—Adult beetles chain-like holes in leaves in July, and la or grubs devour the small feeding r and eat channels in the bark of the la roots and main stem underground, often causing great inj Spray leaves with lead arsenate.

Sphinx and Other Caterpillars—Several species of worms as well as other kinds of caterpillars feed upon leaves. Spray with lead arsenate or practice hand picki

Grape Leafhopper—Small, yellow and red-marked leaf-hoppers sucking sap from under side of leaves. Spray under surface with nicotine solution and soap.

Grape Phylloxera—Sucks sap from roots and leaves, forming galls, and causing serious injury to European varieties. Graft on native species.

Fungi.

Black Rot—Causes reddish-brown spots on leaves; more rarely on stems; rots the berries, which finally become hard, shrunken and black. This is one of the worst diseases of the grape and often difficult to control by spraying. Begin spraying before blossoming time, about the last of May, with second application just after blossoming and subsequent sprayings at intervals of about 10 to 14 days. Usually 4 or 5 sprayings with Bordeaux are sufficient. Repts. 1889, p. 174; 1890, p. 100.

Downy Mildew—Develops, usually, dense white fruiting patches on under side of leaves and more or less discoloration on the upper; occurs somewhat on stems and fruit. With white varieties, like Niagara, may retard maturity, the occasionally infected berries of the bunch remaining hard, white specked, or shelling off prematurely. Treat as for black rot, omitting first treatment. Rept. 1893, p. 77.

Gray Mold—Causes rotting of ripening greenbouse grapes, covering them with a more or less conspicuous grayish mat of fruiting threads. Remove rotting grapes from the house. Use care in ventilating and watering. If necessary spray bunches several times with potassium sulphide.

Powdery Mildew—Produces a cobweb-like growth over upper surface of leaves; most conspicuous in the fall, when the minute, round, yellowish to black fruiting-bodies are fo scattered over surface. Treat as for black rot. Potassi sulphide is also used effectively against this fungus. Re 1895, p. 185.

GRASS.

Insects.

White Grubs—White grubs are the larvae June beetles, and when abundant in the soil a approaching maturity, cause much damage, esp ially in seasons following drought, by eating the roots of grass, corn, strawberries, etc. Pl just before October 1 to expose insects. Harrow very th oughly before planting. Repts. 1912, p. 288; 1915, p. 179.

Asiatic Beetle—Grubs of an introduced species injure law in Westville. Drench with carbon-disulphide emulsion September or May when grubs are near surface. Calci cyanide 4 oz. per sq. yard, watered in will kill grubs but a injures grass. Repts. 1923, p. 291; 1924, p. 294.

Fall Army Worm—Attack similar to that of army worm occurs in September instead of July, and is more apt to be c fined to lawns and millet. The worms do not migrate in s great numbers from one field to another. Sa remedies apply. Also practice late fall plowi Rept. 1912, p. 284.

Army Worm—In certain seasons grasses a grains are stripped of leaves and heads during J by brown striped caterpillars, which when abu ant move like armies from one field to another, of causing great damage. Spray with lead arsen strips of grass or grain to protect fields not attack Plow deep furrows across line of march, turn the furrows towards the line. Sprinkle migrat worms with kerosene. Use poisoned bran ma Rept. 1914, p. 157.

Fungi.

Brown Spot—Caused by a soil fungus that rots off the stems and roots near the surface, the parts above turning brown and dying. Usually starts in small circular spots in lawns in wet seasons. Do not confuse with similar injury due to severe winters and summer droughts. Spray infected spots and adjacent grass every week or two, according to weather, with Bordeaux mixture until spots fail to spread further.

HICKORY.

Insects.

Fall Web-Worm—See Pear.

Walnut Caterpillar—See Walnut.

Hickory Tussock Moth—White and black hairy caterpillars feed upon the leaves in late summer. Spray with lead arsenate. Repts. 1907, p. 332; 1917, p. 325.

Hickory Bark-Beetle—Small black beetles breed under bark and the galleries soon girdle the tree. Adults emerge, leaving numerous round holes as if the bark had received a charge of bird shot. Beetles also feed at base of compound leaf stems, causing them to break and fall in midsummer. Has killed thousands of trees in Atlantic States. Badly infested trees should be removed before May 1, and burned, or at least the bark removed. Spray healthy and slightly infested trees about June 1, with strong lead arsenate and nicotine solution. Repts. 1901, p. 267; 1914, p. 198.

Hickory Borer—Larvae tunnel deep into solid wood of trunk. Hunt for sawdust, find the burrow, inject carbon disulphide, and plug the entrance.

Hickory Gall Aphid—Curious galls on the leaf stems o[illegible] cause the leaves to fall in midsummer. Galls contain la[illegible] number of aphids. Spray with nicotine solution just as [illegible] growth starts in spring. Rept. 1916, p. 145.

HOLLYHOCK.

Fungi.

Rust—Appears as small, compact, redd[illegible] brown pustules on both leaves and stems. [illegible] late fall, cut off the plants close to the gro[illegible] and destroy them. Spraying with Bordeau[illegible] helpful in checking the rust; begin as plants p[illegible] through the ground. Rept. 1895, p. 188.

HORSE CHESTNUT.

Insects.

White-Marked Tussock Moth—Tu[illegible] caterpillars devour leaves in midsum[illegible] Spray with lead arsenate. Repts. 1[illegible] p. 230; 1916, p. 105.

Fungi.

Leaf-Spot—Shows as extended reddish-brown areas on leaves, resembling sun scorch, but showing the fruiting st[illegible] as minute black dots in the dead tissues. This trouble ca[illegible] controlled by spraying with Bordeaux. The first applica[illegible] is made on the unfolding leaves and is followed by tw[illegible] three at intervals of about two weeks.

HORSE RADISH.

Insects.

Flea Beetle—Adults feed on the leaves, and larvae tunne[illegible] the petioles. Spray with Bordeaux mixture and lead arsen[illegible]

IRIS.

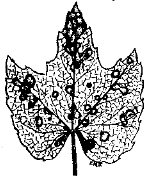
nsects.

Iris Root Borer—Larva tunnels in the rootstocks, injuring nany plants. Destroy infested rootstocks. In bad infesta-ions burn over the beds in winter to destroy the eggs. Repts. 915, p. 189; 1918, p. 331.

'ungi, etc.

Leaf Blight—Occurs as elliptical spots with purplish border; f abundant causes leaves to turn yellow and die prematurely; s worst on German Iris. Keep foliage coated with Bordeaux or lime-sulphur, beginning early; gather and burn infected ubbish in late fall.

Soft Rot—Attacks rootstocks, destroying lower parts so hat leaves turn yellow and die. Same bacterial disease is lescribed under Salsify. Propagate only from healthy stock; plant in well-drained soil; use only well-rotted manure; pre-ent winter injury of roots. Rept. 1903, p. 327.



IVY, BOSTON.

Fungi.

Leaf Spot—Forms conspicuous brownish spots with purplish borders, which run together if abundant. It is the same as leaf stage of black rot of grape. Give several sprayings with commercial lime-sulphur, beginning on unfolding leaves. Burn leaves in fall.

KALE.

Insects.

Turnip Aphid—See Turnip.

Fungi.

Black Rot—Rept. 1915, p. 431. See Cabbage.

LARCH.

Insects.

Larch Sawfly—Larvae defoliate trees in midsummer. Spr with lead arsenate. Rept. 1915, p. 125.

Case Bearer or **Leaf Miner**—Small Lepidopterous larv mine the leaves; pass the winter in cigar-shaped cases on t twigs. Dormant spray of lime-sulphur. Rept. 1923, p. 2

Woolly Aphid—White cottony tufts on the bark and at t leaf whorls. Spray with kerosene emulsion or with nicoti sulphate solution and soap.

LARKSPUR.

Insects.

Mite—Curls leaves and buds of new growth which beco swollen and distorted, often with a purplish color. Sp two or three times each week from first appearance u blossoms open, with nicotine sulphate, 1-400. Rept. 19 p. 176.

Fungi, etc.

Bacterial Leaf Spot—Shows as purple-black, irregular, u ally conspicuous spots on both surfaces of the leaves. Do confuse with the mite injury described above. On first appe ance pick off and destroy infected leaves. In fall cut off pla close to ground and carry away all rubbish.

LETTUCE.

Insects.

Aphid or **Green-Fly**—Sucks sap from leaves. Fumig with tobacco or hydrocyanic acid gas. Spray with soap water.

Fungi, etc.

Drop—Causes sudden wilting of plants by infecting and rotting off leaves at surface of soil; often shows a white moldy growth over the basal parts. This may develop into a serious trouble in the greenhouse, as the fungus often becomes established in the soil, when the best remedy is to change the soil entirely or sterilize it by steam or formalin (formula D). Treat some days before using. Rept. 1908, p. 863.

Head Rots—Are of two kinds in field lettuce—one a basal leaf rot, caused by the same soil fungus that injures lawns, invades the lower leaves in contact with the ground and rots these spreading upward; the other, a bacterial disease, begins at the margins of the leaves but often develops a serious rot more or less hidden within the apparently sound head. Very wet ground or weather is largely responsible for the appearance of either. Rapid growth favored by excess of humus in the soil promotes both. Avoid use of green manures. Keep top soil well dried out by shallow cultivation. Building-paper disks placed under individual plants might hinder infection from the first mentioned.

Leaf Mold and Mildew—The first produces a brownish and the second a white moldy growth in spots on the leaves. These diseases are usually held in check by sub-irrigation or care in watering and ventilating to keep plants and atmosphere as free from moisture as is consistent with good growth. Thoroughly spray young plants with Bordeaux, where feared.

LILAC.

Insects.

Lilac Borer—A white larva tunnels in the twigs. Cut and burn infested twigs. Rept. 1905, p. 260.

Oyster-Shell Scale—See Apple.

San José Scale—See Peach.

Fungi.

Powdery Mildew—Forms whitish cobwebby coating leaves, with mature stage finally abundant as black dots. C spicuous and common, but rarely demands preventive tre ment by spraying.

LILY.

Insects.

Aphid—Yellow aphids with red markings, on under s of leaves. Spray with nicotine solution and soap.

Stalk Borer—See Dahlia.

LINDEN.

Insects.

Canker-Worm—See Apple.

White-Marked Tussock Moth—See Horse Chestnut.

Linden Borer—A white larva tunnels in wood at base trunk. Dig out borer, or inject carbon disulphide. Rept. 19 p. 186.

LOCUST.

Insects.

Locust Borer—Larvae tunnel in solid wood of trunk. Wh new leaves appear, spray bark of trunk and larger branc with mixture made by dissolving ¼ lb. sodium arsenite ir gallons water to which 1 quart of miscible oil is added and whole thoroughly agitated. Beetles will not lay eggs shaded trunks, hence growing trees in thick stands or shadi the trunks is effective.

MANGEL.

Insects.

Leaf Miner—See Beet.

Fungi.

Leaf Blight—Shows as grayish circular spots with purplish borders; when abundant causes premature death of leaves. Rotate; keep refuse out of manure piles; spray with Bordeaux before disease gets started. Rept. 1915, p. 432.

Root Rot—Rots off roots below ground, turning foliage yellow and often killing it. Not common, but injurious occasionally in low wet fields. Avoid wet ground; keep rotted plants out of manure. Rept. 1915, p. 433.

MAPLE.

Insects.

Maple Borer—Larva tunnels in spiral course upward around trunk or larger branches of sugar maple, working in sapwood and cambium, often girdling the trees. Examine trees in September for sawdust. Find the burrow, inject carbon disulphide and plug the opening. Rept. 1922, p. 351.

White-marked Tussock Moth—See Horse Chestnut.

Other Tussock Moths—See Apple.

Canker-Worms—See Apple.

Cottony Maple Scale—Large, oval, brown soft scales on bark of branches of silver and red maples. Each scale in early summer develops a large cotton-like tuft of wax, nearly half an inch long, and soon afterwards the young appea Spray with miscible oils. Rept. 1921, p. 179.

Woolly Maple Leaf Scale—Cottony woolly masses of wax, containing the f males, eggs and sometimes larvae, appear the under side of the leaves of sugar mapl in midsummer; leaves fall prematurel Males and larvae enter crevices of bark trunk and branches; latter pass the wint Attacks only sugar maples. Spray dorma trees with nicotine solution and soap. I not use miscible oils. Burn all infested leaves. Bull. 15 Repts. 1905, p. 226; 1911, p. 345.

Terrapin Scale—Small reddish-brown soft scales on sm twigs of silver and red maples, sometimes killing the branch Spray with kerosene emulsion. Rept. 1921, p. 183.

Oyster-Shell Scale—See Apple.

Maple Aphids—Green aphids are common on under surfa of leaves of Norway and Sycamore maples in June. Spr with nicotine solution and soap, or with kerosene emulsion

Gall Mites—Disfigure leaves by forming galls on upper s face. Destroy infested leaves.

Fungi, etc.

Anthracnose—Causes dead areas in the leaves, often h to distinguish from the leaf scorch. Its appearance deper on character of season. For this reason spraying is of dou ful value in the long run, but when given should start on unfolding leaves. Repts. 1903, p. 329; 1915, p. 436, unus form.

Black (Tar) Spot—Forms slightly thickened black spots on the leaves, resembling finger prints. Cut-leaf maples are especially susceptible. Rake up and burn all leaves in the fall. Rept. 1908, p. 852.

Leaf Scorch—Shows as more or less extended and irregular dead areas, appearing suddenly, usually from the leaf margins inward. A physiological trouble due to sudden or excessive evaporation beyond the supply of water furnished by the roots, which is in turn due to abrupt changes in atmospheric conditions, drought, injury to roots, etc. Pruning, when necessary, watering or mulching, and stimulating root growth by nitrogenous fertilizers are best remedial measures. Rept. 1905, p. 267.

Stag-head—Shows in trees killed at the top or by central branches gradually dying. Due to various agents or unfavorable environment such as parasitic or semiparasitic toadstools and shelf-fungi, escaping gas in soil, winter injury, etc. Cut off dead and dying branches; clean out decaying wood, treat with a wood preservative and fill cavities. Stimulate new growth by nitrogenous fertilizers.

MARGUERITE.

Insects.

Marguerite Fly or **Leaf Miner**—A maggot tunnels between upper and lower leaf surfaces. Spray every ten or twelve days with nicotine solution. Rept. 1915, p. 188.

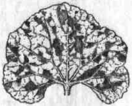
MELON (MUSK).

Insects.

Melon Aphid—Sucks the sap from the under side of the leaves, and when abundant causes much damage. Underspray the leaves with nicotine solution and soap. Dust with n tine. Bull. 216, p. 47; Rept. 1908, p. 813.

Striped Cucumber Beetle—See Cucumber.

Fungi.



Anthracnose—Appears occasionally. Cucumber.

Downy Mildew—Causes angular, eve ally brown spots in the leaves, often ki vines; most prominent just before me ripen, later ones not maturing or worth Begin spraying with Bordeaux mixtures soon after the v start to run, and keep them covered to the end of the sea In very wet seasons spraying is not entirely effective. F 1904, p. 329.

Leaf Mold—Develops dead spots on the leaves very sin to those caused by downy mildew. Spray with Bordeau the first running vines and repeat every 10 to 14 days, ma 4 or 5 applications according to season. Repts. 1895, p. 1898, p. 225.

Wilt—See Squash.

MILLET.

Insects.

Fall Army Worm—See Grass.

NASTURTIUM.

Insects.

Aphid—Brown aphids cluster on stems and leaves, suc the sap. Spray with nicotine solution and soap.

OAK.

Insects.

Canker-Worms—See Apple.

Gipsy Moth—See Apple.

Brown-Tail Moth—See Pear.

Orange-striped Oak-Worm—Black and orange striped caterpillars feed upon the leaves late in summer. Spray with lead arsenate.

Fungi.

Anthracnose—Appears as light-brown spots on the young leaves, killing some before they unfold. Infection comes from spores produced in inconspicuous pustules on the young twigs. Treat as for anthracnose of sycamore.

Leaf Curl—Appears, not uncommonly on certain species of park and lawn oaks, as a dense violet-gray felt in cupped areas on under side of the leaves with the upper surface elevated and light colored. Without definite experience we recommend same treatment as for peach leaf curl, namely, a dormant spray with lime-sulphur, 1 to 9, just before buds begin to swell.

Heart Rots—Develop occasionally hoof-shaped or bracket fungi on trunks. Gain entrance through wounded and dead branches; cause rot of heart wood and sometimes slow death of sapwood and bark. Break off and burn fruiting bodies; cut out diseased bark and sapwood, and dig out infected heartwood; fill cavity if desired. Occur in other deciduous trees, especially maples. Bull. 222, p. 446.

OATS.

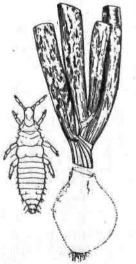
Insects.

Army Worm—See Grass.

Fungi.

Black Stem Rust—Forms, chiefly on leaf shea and stems, first the II stage as reddish pustules later the III stage as elongated black outbrea Also occurs on wheat, rye, and other grasses as ferent strains. The I stage appears in spring barberry leaves as cluster-cups, but the fungus skip this stage. Quite serious in regions wh grain is grown extensively, and difficult to cont This and several related species are becoming m important here as more grain of various kind grown. Cut out barberries in vicinity of fields.

Smut—Destroys the grain, turning it into a black dusty m of spores. Seed treatment will prevent this smut. Either s the seed 12 minutes in water at 133° F., and dry thoroug or sprinkle quickly with formalin (formula A), stirring grain so that it is thoroughly wet, and leave in piles for sev hours before drying out. A less cumbersome treatment c ing into general use is that given ur formula B. Buy seed from smut-free fie



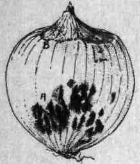
ONION.

Insects.

Thrips or **"White Blast"**—Very smal sects which feed upon the surface of leaves, giving the field a whitish app ance. Burn all tops and refuse; burn the grass land around the field to kill c wintering insects. Spray with nicotine s tion and soap, or kerosene emulsion. R 1903, p. 266; 1913, p. 233.

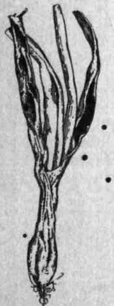
Maggot—Infests the bulb of the yo plant. Practice rotation of crops. S

plants here and there over the field with sweetened lead arsenate to kill the adult flies. Rept. 1911, p. 286.



Fungi.

Anthracnose (Black Spot)—Shows as black circular spots on the bulbs, usually on white varieties after storing. Store onions as dry as possible and keep barn dry and cool. Avoid piling too deeply in bins. Air-slaked lime mixed with sulphur scattered over them at time of storing may prove beneficial. See Stem Rot for treatment with formalin fumes. Fig. (A). Rept. 1889, p. 163.



Smut—Forms black dusty outbreaks on various parts of plant raised from seed; especially injurious to the very young seedlings. This fungus becomes established in the soil, hence infected land should be avoided or used only for transplanted onions. If used, apply with the seed in drills per acre, 100 lbs. sulphur thoroughly mixed with 50 lbs. air-slaked lime. Formalin (1 lb. or 1 pt. to 12 gallons water) thoroughly sprinkled over the seed, before covered, by drip attachment to the seeder, is an even more desirable remedy. Repts. 1889, p. 129; 1895, p. 176.

Stem Rot—Starts rotting of bulbs at stem end, where they become soft and shrunken, sometimes showing beneath the layers a dense olive-brown growth. This fungus in a moist season occurs on various parts of the plant in the field (possibly responsible for "blast" of seed onions), but does not appear as a serious trouble with the bulbs until some time after they have been placed in the barn. Treat [...] black spot. Late field spraying with Bordeaux shortly [...] pulling and again while lying in the field, combined with [...] ment by formalin fumes (See Fungicides) after storin[g] [...] given some indications of benefit. See Fig. (B) under an[thrac]nose. Repts. 1903, p. 334; 1904, p. 321.

PALMS.

Insects.

Scales—Several kinds of white and brown scales infe[st] species of palms grown in greenhouses. Apply nicotine [solu]tion or soap and water as a spray or as a dip.

Fungi.

Anthracnose—Frequently causes leaves to die at tip. [...] gus may show as small black imbedded specks oozing p[...] masses of spores. Avoid infected stock or isolate it; p[...] and burn worst infected leaves; keep leaves dry and [...] well ventilated. Rept. 1913, p. 18.

PARSLEY-PARSNIP.

Insects.

Celery Caterpillar—On both hosts. See Celery.

Parsley Stalk Weevil—Larva tunnels in crown of plan[t] [...] remedy other than to destroy infested plants. Rept. [...] p. 252.

Fungi.

Drop—On Parsley. See Lettuce.

Soft Rot—On Parsnip. See Salsify.

PEA.

Insects.

Green Pea Aphid—Attacks the plants early in Jun[e] [...] sucks the sap from the leaves and stems, often causing

injury. Early peas may mature a crop before aphids injure them. Spray or dust vines with nicotine. Brush the vines just before cultivating. Repts. 1899, p. 240; 1913, p. 235; 1924, p. 319.

Pea Weevil—The adult lays eggs in the pods in the field and the larvae develop in the seed, the beetles emerging through round holes. Fumigate with carbon disulphide as soon as harvested. Bull. 195, p. 5.

Fungi.

Leaf Spot and **Powdery Mildew**—Shows in the former as roundish spots on both pods and leaves; in the latter, as a mealy or cobweb-like coating on same. Neither seems to be sufficiently injurious here to warrant the expense of spraying.

Root-Rot—Kills tops of roots and base of vines, causing parts above to turn yellow, wilt and die prematurely. Caused by various soil fungi. Practice rotation, use *well-rotted* manure; give frequent cultivation in wet years to hasten the drying of the top soil; plant most resistant varieties. Bull. 222, p. 450.

PEACH.

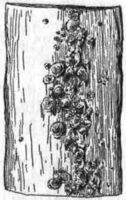
Insects.

Peach Sawfly—Larvae feed upon leaves in June and July. Spray with lead arsenate. Rept. 1907, p. 285.

Peach Borer—Larva tunnels in the base of the trunk. Dig out in late fall and early spring. Paint base of trunk with lead arsenate and lime-sulphur. Remove top soil and sprinkle powdered paradichlorobenzene around the trunk, using about 1 ounce per tree, and cover with soil. Rept. 1909, p. 359.

Oriental Peach Moth—Larvae tunn new shoots early in season, later broo leave shoots and enter fruit or go dire into fruit; larvae winter in cocoons bark or on ground. No satisfactory co trols yet known. Frequent sprays nicotine sulphate and soap, cultivation soil in fall or early spring in localiti permitting it, and the use of paradichlo benzene the same as for peach borer control, have been sho to be of some benefit. Rept. 1924, p. 299.

Fruit Bark-Beetle or **Shot-Hole Borer**—Makes minute tu nels under the bark of branches and trunk. Burn infest trees and keep others thrifty. Rept. 18 p. 240.

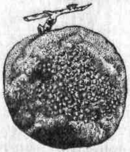


Plum Curculio—See Plum.

San José Scale—Minute scale insec with circular shell, which suck the sap fr twigs, fruit and leaves. On fruit a red s surrounds each insect. Spray dorm trees with *lime-sulphur* or *miscible o* Bull. 165; Rept. 1901, p. 240.

Black and **Green Aphids**—Suck the s from the leaves and shoots. Spray w nicotine solution.

Fungi, etc.



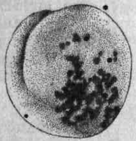
Brown Rot—Occurs on the young twi leaves and blossoms, but causes most se ous injury to the fruit, rotting it ab ripening time. The rotten areas beco covered with numerous pustules of du brownish spores; eventually the disea fruits form hard mummies. These ca

the fungus over the winter, and if half buried in the soil develop in early spring the mature stage, which causes infection of the blossoms, etc. Certain early varieties, like the Champion, are especially subject to rot. See general directions for treatment. This fungus occurs on plums and cherries and less commonly on pears and apples. Repts. 1909-10, pp. 607, 612; 1911, pp. 374, 391.

Crown Gall—See Plum.

Leaf Curl—Causes young leaves to become irregularly curled and swollen and finally to drop off; rarely on fruit. In April as soon as buds begin to swell, spray the trees thoroughly with commercial lime-sulphur, 1-9. Same treatment takes care of San José scale. Repts. 1909-10, pp. 608, 612; 1911, p. 374; 1914, p. 19.

Powdery Mildew—Forms a grayish felt on young twigs and leaves. Prune off infected twigs; give winter treatment as for leaf curl, and summer treatment as for scab and brown rot.



Scab — Produces roundish, olive-black spots on the fruit, discolored areas on the young twigs, and rarely "shot-holes" in the foliage. Two treatments with self-boiled lime-sulphur, dry mix or Atomic Sulphur upon the fruit after setting and when half grown (about the middle of May and June) will control this trouble. Repts. 1896, p. 269; 1909-10, pp. 608, 614; 1911, pp. 375, 391.

Spray Injury—Is more likely to occur than on apple. Avoid Bordeaux altogether. See (3) under general treatment following. Repts. 1900, p. 219; 1911, p. 372.

Winter Injury—Shows in various ways. In severe winte especially when the ground is bare, the roots may be kil without injury to parts above the ground. In spring su trees put forth a scanty sickly foliage that soon drops. Of the injury occurs in the form of a "collar girdle" in the b at the base of the tree. Sometimes it occurs above ground the wood (shown by its blacker color), with or without inj to the bark. When the bark is not injured, severe pruning spring will often save the trees. Nursery trees can someti be cut back to the snow line, below the injury, and an enti new healthy trunk started. Avoid late applications of ni genous fertilizers and cultivation after middle of July. Mu base of young trees in late fall with earth. Secure good dr age. Repts. 1903, p. 341; 1908, p. 872.

Yellows—Causes premature ripening and red spotting fruit, develops yellowish curled leaves, and in time spindl sprout growth in bunches on the trunk. This is claimed to a contagious disease, but it is apparently physiological nature. Little peach in this state is scarcely to be dis guished from the yellows, showing chiefly in the small ba ward fruit. Root out all infected trees; prevent winter inju be careful in selecting stock for planting. Nurserymen sho use especial care in selecting their stock for budding. Re 1893, p. 92; 1908, p. 872.

General Treatment for Peach Orchards.

(1) Spraying peaches while dormant is of value only checking San José scale, mites and leaf curl. One applica of commercial lime-sulphur, 1-9, either in late fall, or pre ably early spring, will take care of all of these troubles. the scale and the leaf curl are unusually prevalent both ap cations will prove of value in controlling them.

(2) For the prevention of scab and rot of peaches, give three sprayings, as follows: 1st, shortly after the blossoms have fallen; 2d, three or four weeks later; and 3d, one month later. Dusting with sulphur may replace spraying where more convenient.

(3) Self-boiled lime-sulphur, dry mix and Atomic Sulphur seem to be the safest and most reliable peach sprays. Fair results have been obtained with some of the commercial lime-sulphurs, and they are much more easily handled. There is, however, some danger of spray injury, especially with certain brands. If commercial lime-sulphur is used, a strength of not greater than 1-150, without poison, is advisable.

(4) As lead arsenate has done little to prevent curculio injury in Connecticut and as it seems to increase the danger of spray injury, we advise leaving it out unless there is considerable danger from the sawfly, when it can be added in the second spraying the same as for apples.

PEAR.

Insects, etc.

Pear or **Cherry Slug**—See Cherry.

Codling-Moth—See Apple.

Brown-Tail Moth—Occurs in the United States only in eastern New England. Brown hairy caterpillars feed on leaves, and make winter nests on twigs, maturing about the middle of June. Cut and burn winter nests. Spray foliage as soon as blossoms fall, and also in August, with lead arsenate. Rept. 1910, p. 683; Bull. 182.

Fall Web-Worm—Makes nests on ends of branches of many kinds of trees in late summer, the brown, hairy caterpillars feeding inside the nests. Clip off and burn nests when small. Spray with lead arsenate. Repts. 1901, p. 270; 1917, p. 319.

San José Scale—See Peach.

Pear Psylla—Small jumping plant lice suck sap from lea and twigs, causing leaves to fall in midsummer. Spray v lime sulphur 1-9 in spring just before the blossom buds o Spray again in July with nicotine sulphate and soap, or n tine sulphate and lime using 20 lbs. of lime to each 50 gall spray. If infestation is bad spray on warm days in spr or fall with nicotine and soap to destroy adults. Rept. 1 p. 262.

Sinuate Pear Borer—Grubs tunnel in branches often ing them. Cut out the borers and spray foliage heavily May with lead arsenate. Rept. 1920, p. 193.

Pear Thrips—A minute insect which feeds upon the opened fruit buds, destroying them so that fruit does not Spray with nicotine solution and soap just as buds open, again after blossoms fall.

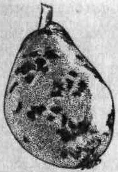
False Tarnished Plant Bug—Punctures developing fr causing it to be irregular and knotty. Spray with nico solution and soap.

Leaf Blister Mite—Attacks unfolding leaves of apple pear; forms galls or blisters, which become red and l brown. Causes many leaves to fall in July. Spray dorm trees with lime-sulphur in late fall or in spring. Rept. 1 p. 700.

Fungi, etc.

Blight—Kills young twigs, the leaves suddenly turn black; also produces sunken dead areas on trunks. is a bacterial disease chiefly spread by bees during bloss ing time, or by sucking insects. Winter-prune all disea branches, cutting off several inches below diseased area. out cankered areas and swab with disinfectant, paint expo wood when dry. Several times after blossoming remove young dead twigs. Use knife sterilized after each cut

wiping with a cloth saturated with carbolic acid or with corrosive sublimate (1-1000). Rept. 1894, p. 113.



Leaf Blight—See Quince.

Scab—Forms olive-black scabby spots on fruit and leaves, often causing the former to become distorted and cracked. The fungus lives over winter on the twigs. Certain varieties are not much injured, others, like Flemish Beauty, are very susceptible. Spray as for apple scab. Repts. 1894, p. 135; 1904, p. 323; 1911, p. 396.

PEONY.

Insects.

Rose Chafer—Adult beetles feed upon blossoms of white varieties. See Grape.

Fungi.

Stem Rots—Appear in the spring as the new stems push up into the air. Sometimes the tip, the base or the whole stem may die from the rot. Two different fungi cause the same injury. Spray plants and soil as the stems push through the earth; keep soil dry by stirring; destroy infected stems.

PHLOX.

Insects.

Red Spider—Injures leaves, causing them to turn yellow. Clean culture. Spray clear water with force from hose, and in severe infestations, with linseed oil emulsion, kerosene emulsion, or with nicotine solution and soap.

Fungi.

Powdery Mildew—Covers more or less completely leaves and young stems with grayish coating within which are finally imbedded numerous, small, blackish fruiting-bodies. Give [...] eral sprayings with commercial lime-sulphur, starting b[...] mildew appears.

PINE.

Insects.

Sawflies—Larvae of several native and imported sp[...] feed upon the leaves. Spray with lead arsenate. Rept. [...] p. 273.

White Pine Weevil—Adult snout beetle lays eggs on l[...] in May and grubs feed and develop on it, causing it to wil[...] die in midsummer. Leaders of ornamental trees may be [...]tected by spraying them with lead arsenate or lime-sul[...] Jarring the adults into a net once a week during month of [...] serves greatly to reduce the damage. Infested leaders s[...] be cut and destroyed. Repts. 1911, p. 307; 1919, p. 144.

Pine Leaf Scale—Whitish pear-shaped shells on le[...] small trees sometimes killed. Spray with nicotine soluti[...] kerosene emulsion about the second week in June. [...] 1921, p. 181.

Pine Bark Aphid—White cottony or woolly objects on [...] and sometimes on leaves, sucking out the sap. Spray [...] kerosene emulsion. Repts. 1911, p. 343; 1919, p. 155.

Fungi, etc.

Blight (so-called)—Stunts the leaves and kills their [...] often suddenly, so that the tissues for a greater or less dis[...] are reddish-brown. This is a physiological disease; it i[...] contagious; due to adverse weather conditions. Chief a[...] these are severe winters, killing the leaves directly or indi[...] through injury to roots; warm days, in late winter or [...] spring when ground is frozen, causing transpiration of [...]

from the leaves that cannot be replaced; very late spring frosts, killing tips of new leaves; sudden changes, in summer from moist or muggy weather to bright sunshine, resulting in excessive transpiration and injury; very dry summers. No effective remedy. Rept. 1907, p. 353.

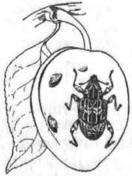
Dampening Off—Caused here chiefly by Rhizoctonia fungus rotting base of the stem, the seedling falling over. Sometimes it creeps up the stem, invading the base of the leaves which wither. Certain conifers are more subject to attack than others. Avoid unnecessary watering; provide good ventilation; infected soil often can be helped by treatment with formalin before seeding (see Fungicides, formalin D); spraying with Bordeaux is helpful in some cases. Some use sand as a coating over the beds. Repts. 1912, p. 348; 1915, p. 450.

Stem Rusts—Form on the swollen stems temporary, but conspicuous, white, blister-like spore cups filled with a dusty orange-colored spore mass. The white pine blister rust, an imported species, spreads to the gooseberries and currants, and forms other less conspicuous leaf stages on these. A very similar native species on two and three needle pines spreads to the leaves of the sweet fern. In either case infected pines should be destroyed, and also the alternate hosts, if they occur in the neighborhood. Spray seed-beds with Bordeaux if liable to infection. In white pine plantations *pull out all currant and gooseberries within 500 feet.* Send any suspicious white pines or their alternate hosts to this Station for examination. Rept. 1912, p. 347; Bulls. 214, p. 428, 237, p. 305.

PLUM.

Insects.

Plum Aphids—Suck sap from leaves. Spray with keros emulsion, *nicotine solution and soap, or with soap and wa*



San José Scale—See Peach.

Plum Curculio—Grub infests the gr ing fruit, causing it to fall. Jar the tr each morning for six weeks after bloom and catch the beetles on sheets and dest them. Spraying with lead arsenate dur the same period is also advised. Rept. 19 p. 609; Bull. 235, p. 218.

Fruit Bark-Beetle or **Shot-Hole Bore** See Peach.

Fungi.

Black Knot—See Cherry.

Brown Rot—*Is the same as on peach. Thin fruit so it d* not touch. Gather and destroy all mummies after harv Rather difficult to control by spraying, as spray does readily adhere to the smooth fruit. First treatment w Atomic Sulphur, dry mix or self-boiled lime-sulphur, sho be made on half grown fruit, others at intervals of two wee and the last one 7 to 10 days before picking. Use a sprea in the spray.

Crown Gall—Shows hard roundish knots one-half inch more in diameter, near crown or on roots, less frequently *lower part of trunk. Do not plant infected trees.* Rem knots when found and paint over cut surface. This is said be very troublesome in some states, but here, as yet, li damage has resulted from it.

POPLAR.

Insects.

Poplar Tent-Maker—Larvae feed on leaves and fold them together near ends of branches, forming nests. Spray with lead arsenate. Rept. 1911, p. 310.

Spiny Elm Caterpillar—See Elm.

Tussock Moths—See Apple, Hickory and Horse Chestnut.

Poplar Borer—Larvae make large galleries in wood of trunk. Dig out, or inject carbon disulphide into the burrow and close the opening. Rept. 1907, p. 336.

Poplar and **Willow Curculio**—Larva tunnels in smaller trunk and branches. Destroy badly infested trees. Cut out borers; inject carbon disulphide. Rept. 1907, p. 335.

Oyster-Shell Scale—See Apple.

Fungi.

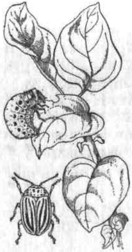
European Canker—Forms sunken dead areas of varying extent in the bark. Importation from Europe; showing here most commonly on Lombardy and white poplars. If trees are badly injured cut down and burn; otherwise cut out diseased areas going into the healthy bark, scraping and painting over exposed wood. Bull. 222, p. 461.

Rusts—Show on leaves as minute, powdery, yellow-orange pustules in II stage, and as slightly elevated reddish blisters in III stage. Have I stage, for different species, on larch and hemlock. Avoid planting near these hosts in nursery; rake up and burn infected leaves in the fall. Rept. 1915, p. 440.

POPPY.

Insects.

Aphids—Black aphids suck sap from stems and leaves. Spray with nicotine solution and soap.



POTATO.

Insects.

Flea Beetle—Small black jumping be eat holes through the leaves. Spray hea both upper and under leaf surfaces with arsenate or calcium arsenate. Bull. 20 103; Rept. 1906, p. 271.

Colorado Beetle—Adults and larvae vour the leaves. Spray with lead arse as soon as injury is apparent. May be in Bordeaux mixture. Bull. 208, p. Rept. 1911, p. 311.

Three Lined Potato Beetle—Larvae upon the leaves and carry their black e ment on their backs. Spray with lead nate. Bull. 208, p. 109.

Stalk Borer—Larva tunnels inside the stalk. Burn inf vines. See Dahlia. Bull. 208, p. 111.

Leafhopper—Sucks sap from veins, c ing leaves to curl and "burn." Know "hopper burn." Spray or dust with tine to kill leafhoppers.

Potato Aphid—Green and pink aphid pearing in large numbers suck the sap shoots and stems, causing much damag 1917. Spray or dust with nicotine. 208, p. 115.

Fungi, etc.

Black Leg—Ends as a black rot of stem below gro makes plants usually stunted with yellowish curled foli occasionally rots tubers. Usually only scattered plants ap in the field, not spreading to the healthy. Soaking see formalin as for scab is helpful. Plant only certified Rept. 1914, p. 21.

Blight or **Downy Mildew**—Causes a sudden blackening of the leaves, and death of vines, from July to September in moist seasons; usually shows a slight whitish growth of fungus on the under side of the leaves; rots tubers. Spray with Bordeaux before the trouble appears, about July 1, and keep vines *well covered* to the end of the season. Three to five sprayings by hand or five to seven by power sprayer are necessary. Use lead arsenate in the early sprayings for insects. **After last cultivation thoroughly** ridge up the rows to help keep the spores from washing down to the tubers. Early varieties usually escape blight by maturing before its appearance. Repts. 1904, p. 363; 1905, p. 304; 1909-10, p. 739; 1915, p. 470; 1916, p. 355; Bull. 214, p. 411.

Mosaic—Shows as a more or less conspicuous yellow-green mottling of the leaves. A physiological disease not well understood. Common here, but apparently not so injurious as in some other places. Do not save tubers for planting from fields showing this trouble. Keep down aphids. Use only certified seed. Bull. 222, p. 464.

Scab—Produces the common scabby appearance on surface of tubers. Soak uncut seed-tubers one hour in formalin (formula C). Formalin fumes (see Less-Used Fungicides) are often used when large quantities are treated. Care in filling space sufficiently, however, is necessary to avoid injury by "pitting" from absorption of fumes. Corrosive sublimate is recommended by some investigators, especially where the black scurf (Rhizoctonia) also occurs on the tubers, as this treatment seems more effective against latter. Pre-sprinkling with water 48 hours before treatı and keeping moist meantime is said to increase their efficie Hot corrosive sublimate or formalin for short periods has been recommended for potato tuber diseases. Avoid plar on infected land. The use of lime, wood ashes, and va barnyard manures will increase the amount of scab. same trouble occurs on beets and turnips. Fig. (B). R 1890, p. 81; 1891, p. 153; 1894, p. 118; 1895, p. 166; p. 246; 1909-10, p. 744.

Tip or **Hopper Burn**—Causes leaves to die at tip and gins and roll up; often mistaken for true blight. This physiological trouble due to drought or sudden change moist to very hot bright weather or to leafhoppers. C vate thoroughly and often to conserve moisture. Spray Bordeaux as for blight, as this often helps to increase yiel lengthening life of leaves. Rept. 1909-10, p. 742.

PRIVET.

Insects.

Aphids—Suck sap from the leaves causing them to Spray with nicotine sulphate or apply nicotine dust.

Fungi, etc.

Anthracnose—Forms small cankers on stems, causing above to wilt and die. Usually found in nurseries on rec transplanted European privet. Prune off and burn inf branches; spray with Bordeaux. Rept. 1914, p. 22.

Winter Injury—Shows in spring by stems usually killed down to base or snow line. Cut off dead stems b injury and a vigorous new growth will result if roots ar injured. Rept. 1904, p. 326.

QUINCE.

Insects.

Aphid—See Apple.

Oriental Peach Moth—See Peach.

Quince Curculio—Grubs infest growing fruit and adults feed upon it, causing it to be knotty. Jar the trees same as for plum curculio. Spray with lead arsenate about July 1, and repeat in 10 days.

Round-Headed Borer—See Apple.

Fungi, etc.

Black Rot—Affects the fruit, often beginning at the blossom end; also kills twigs and branches. In the fall or spring cut off and burn all dead branches. Give three sprayings, as for leaf blight, with Bordeaux mixture.

Blight—See Pear.

Leaf Blight—Appears as rounded, often confluent, reddish-brown spots with central black dots on leaves and as black sunken specks on fruit, the former often shedding prematurely and the latter cracking irregularly. Spray with Bordeaux just before blossoms open, again soon after they fall, and follow with one or two additional treatments at intervals of about two weeks, according to the weather. This fungus also occurs on pear. Repts. 1890, p. 99; 1891, p. 150.

Rust—Produces small clustered cups, with fringed borders, filled with orange spores, on fruit, young twigs and less frequently on leaves. Cut off and burn infected twigs and fruit. Look for infected cedars in neighborhood.

RADISH.

Insects.

Maggot—See Cabbage.

Aphid—See Turnip.

Fungi.

Club Root—See Cabbage.

RASPBERRY.

Insects.

Raspberry Sawfly—Larvae devour leaves. Spray with arsenate or hellebore. Rept. 1918, p. 329.

Cane Borer—Larva tunnels inside the canes. Cut and infested canes.

Raspberry Fruit-Worm—Brown beetles feed upon leaves and blossoms, and white larvae adhere to berrie picking time. Spray with lead arsenate when beetles appear. Bull. 251.

Fungi, etc.

Anthracnose—Shows as more or less confluent whitish s with purplish borders, on the stems. In spring, before swell, cut out and burn all badly infected canes and then s with Resin-Bordeaux or Bordeaux with a casein spreader disease is very bad, spray again when young shoots are a six inches high, and repeat in 10 to 14 days. Aim chief cover the young shoots with the spray. After fruit is gath again remove any badly infected canes. Cultivate gr thoroughly to promote vigorous growth of canes. Rept. p. 274.

Crown Gall—See Blackberry.

Rust—See Blackberry.

Wilt—Forms cankered areas on the canes, causing the above to wilt. In the old canes and near the pruned ends fungus often develops a brownish coating of spores ar each small imbedded fruiting receptacle. Spraying has proved very satisfactory. Old and diseased canes shoul removed and burned after the fruiting season and again in spring. Rept. 1906, p. 321.

Yellows—Is a more general term for Mosaic (mo leaves), leaf curl and blue stem, three diseases causing se

trouble here. Plants gradually become worthless. Spraying, except for aphids, does not help these troubles. Dig out infected plants. Propagate only from perfectly healthy and most resistant varieties, or buy from inspected stock.

RHODODENDRON.

Insects.

Rhododendron Lace Bug—This bug sucks the sap from the under side of the leaves, which are usually colored brown by its excrement. Spray with nicotine solution or kerosene emulsion. Rept. 1921, p. 201.

Rhododendron Borer—Tunnels under bark of stems around crotches. Cut out borers and cover wounds with melted paraffin. Rept. 1922, p. 347.

Fungi, etc.

Leaf Scorch—Shows as dead marginal areas of varying width usually appearing suddenly. Plant in shade; keep ground mulched; water if necessary in dry weather by soaking ground beneath mulch. Rept. 1914, p. 23.

ROSE.

Insects.

Rose Slug—Eats away the green portion of the leaves. Spray with hellebore, lead arsenate or nicotine solution.

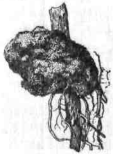
Rose Midge—Larvae distort young leaves and flower buds in greenhouses. Apply tobacco dust to the soil and fumigate nightly with tobacco stems or nicotine paper.

Rose Chafer—See Grape.

Leafhopper—Sucks the sap from the under side of the leaves. Spray with nicotine solution and soap.

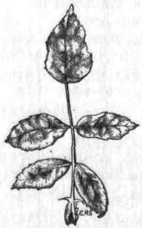
Rose Scale—Whitish circular shells on the stems co insects which suck the sap. Cut and burn worst inf canes. Spray with nicotine solution and soap. Bull. p. 11; Rept. 1905, p. 241.

Aphid or **Green Fly**—Sucks sap from the leaves and s Spray with nicotine solution.



Fungi, etc.

Crown Gall—Occurs very frequently on roots, especially those of Manetti stock. cleaned tools in grafting and avoid inf plants. See Plum. Rept. 1911-12, p. 355.



Leaf Blotch—Forms large purple- blotches on leaflets which often turn y and fall off. For greenhouse treatment hot water pipes with mixture of su and oil. Potassium sulphide or con cial lime and sulphur can be sprayed o foliage. Spraying out of doors ca done with Bordeaux, if there is no c tion to the sediment on leaves. Rept. p. 355.

Mildew—Develops a white powde cobweb-like growth on the young le which become more or less distorted fall off; occasionally blasts blossor certain varieties. Tea roses especially ceptible. Treat same as for leaf bl or dust flowers of sulphur over the leaves; be careful in a greenhouses. Rept. 1903, p. 356. Bull. 222, p. 474.

RUTABAGA, See **TURNIP.**

RYE.

Insects.

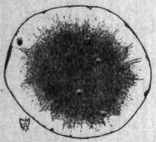
Army Worm—See Grass.
Wheat Midge—See Wheat.

Fungi.

Ergot—Forms conspicuous, elongated, purplish sclerotia, usually one in the spike, most common in volunteer rye, but occasionally in cultivated fields. Keep these sclerotia out of cattle feed, as they may cause abortion and other troubles.

Powdery Mildew—Shows as a thick grayish felt on the leaves with fruiting bodies as blackish embedded specks. Causes premature death of leaves; often associated with rust. No practical remedy. Rept. 1909-10, p. 735.

SALSIFY.



Fungi, etc.

Soft Rot—Caused by bacteria in the interior tissues of the roots, running down from the crown, and turning them a darker color. Usually occurs after storage. Avoid contaminated manure and too much rotting humus in the fields; store under dry cool conditions, allowing sufficient ventilation. Rept. 1914, p. 25.

SNAPDRAGON.

Insects, etc.

Leaf Mites—Cause leaves to curl and plants do not blossom. Spray with nicotine solution and soap, same as for Cyclam Rept. 1914, p. 176.

Root-Knot Eelworm—Causes irregular swellings on roots where the eelworms are present, with resulting premat

decay and sickly appearance of parts ab ground. Worst in greenhouses and l beds, as this far north the nematodes killed in unprotected ground over wi Attacks roots of a great variety of c vated plants. Purchase only healthy pla change infected soil if possible, dry out t oughly in summer, leave out doors winter or sterilize with steam; avoid tamination of soil with infected ref Rept. 1915, p. 452.

Fungi.

Anthracnose—Shows as whitish spots with distinct purp border on leaves and stems; spots often run together. Se seed and cuttings only from healthy stock; pick off and b infected leaves. Spray with Bordeaux.

Rust—Forms reddish-brown, roundish pustules chiefly under side of leaves, causing tissues above to become ye spotted. Appears in greenhouses and causes more or injury according to prevalence. Treat as for anthracn Rept. 1915, p. 443.

SNOWBALL.

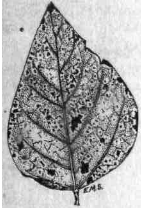
Insects.

Aphids—Suck sap from the leaves, causing them to Use nicotine solution and soap as a spray or dip.

Fungi, etc.

SOY BEAN.

Bacterial Leaf Spot—Appears as small, dark, reddish-brown angular spots frequently merging into larger areas. Certain varieties are more susceptible than others, Ito San being one of the worst. Grow least susceptible varieties and if possible purchase seed from uninfected fields.



Crinkling Chlorosis—Shows as crinkling or yellowish-green mottling of leaves, or both together. Plants less vigorous than normal ones. Hollybrook variety apt to show trouble most. Treatment same as in preceding.

SPINACH.

Insects.

Spinach or **Beet Leaf-Miner**—See Beet.

Fungi.

Downy Mildew Blight—Forms conspicuous yellow spots on the leaves with a purplish-gray growth on the under surface. Unusually conspicuous recently. Little resistance shown by any variety. Disease worse in wet springs and in fields where spinach has been grown for some years. Practice rotation in isolated fields if feasible. Keep down the weed called Lambs Quarters as it is attacked by same fungus and is chiefly responsible for harboring the mature stage over winter.

SPIRAEA.

Insects.

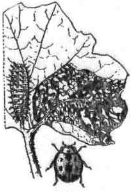
Aphids—Suck sap from the new shoots. Use nicotine solution and soap as a spray or dip.

SPRUCE.

Insects.

Spruce Gall Aphid—Forms galls at the base of the ne growth on Norway and other spruces. Spray in the late f or early spring with nicotine solution and soap or with ker sene emulsion. Repts. 1906, p. 302; 1922, p. 357.

Spruce Bud Moth—Larva feeds on leaves of terminal shoo of the branches, causing much damage. Spray with le arsenate. Rept. 1922, p. 357.

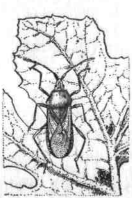


SQUASH-PUMPKIN.

Insects.

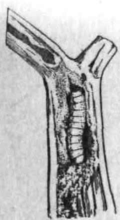
Squash Lady-Beetle—Both adults a larvae devour the leaves. Spray with le arsenate. Bull. 181, p. 11; 216, p. 42; Re 1908, p. 810.

Striped Cucumber Beetle—See Cucumb



Squash Bug or **"Stink Bug"**—A bro bug three-fourths of an inch in length suc the sap from the under side of the leav which wilt and die. Spray with kerose emulsion to kill the young. Bull. 216, p. Rept. 1908, p. 811.

Squash-Vine Borer—Larva tunnels in t base of the stem, causing decay. Spr once a week during July around base stems with nicotine sulphate (1-250). (slits lengthwise in the stem and kill bore



Cover the joints of the vine with earth so that new shoots may be formed to support the plant. Grow a few early plants for traps, and destroy them. The main crop should be planted rather late. Bull. 216, p. 39; Rept. 1908, p. 806.

Fungi, etc.

Anthracnose—See Watermelon.

Storage Rots—Caused by various fungi that are best held in check by storage under conditions with minimum of heat and moisture.

Wilts—Cause leaves of the plants to wilt and then dry up, sometimes all of the vine thus suddenly dying. If a cross sec-

tion of the stem shows a slight milky and sticky exudation, it is caused by bacteria that clog up the water ducts. Fungi in the ducts or insects at the roots may cause similar injury. Heavy manuring often develops these troubles. *Spraying* is of little value except as it may keep off insects which inoculate the plants with the bacteria. Use enough seed to allow for loss by wilt and pull up and destroy all the wilted vines as they appear. Rept. 1903, p. 359.

STRAWBERRY.

Insects.

Strawberry Sawflies—Larvae devour leaves. Spray with lead arsenate or hellebore.

Strawberry Weevil—Small snout beetles; females cut off blossom buds of staminate varieties when ovipositing. Plant pistillate varieties in part. Dust heavily with lead arse and sulphur (1-5).

Strawberry Crown Borer—Grub tunnels and feeds in cr of plant. Practice crop rotation. Burn over infested field in

Strawberry Flea Beetle—Adults eat holes through leaves. Spray with lead arsenate.

Strawberry Leaf Roller—Larva rolls leaf and feeds in Spray with lead arsenate. Burn fields and plow aband fields as soon as crop is harvested.

Strawberry Root Aphid—Sucks sap from leaves and r killing plants. Set clean plants on land not infested. S with nicotine solution and soap.

Strawberry White Fly—Sucks *sap from* leaves. Ur spray with nicotine solution and soap.

White Grubs—See Grass.

Fungi.

Leaf Spot and **Blotch**—Appear as spicuous discolored spots, the former us with whitish centers and purplish bor and the latter with dark centers. Glen N sometimes severely injured by latter. new the beds frequently. In the late fa early spring cut off leaves with mower, add a little s where necessary, and burn over beds. Spray with Bord two or three times before blossoming, beginning last of and repeating weekly, and once after blossoming is Repts. 1903, p. 360; 1914, p. 5.

Powdery Mildew—Covers leaves (more frequently on u but more conspicuously, when present, on upper surface) cobweb-like growth, often causing them to become stiff curled inward. This can be controlled with Bordeau sprayed before abundant. Rept. 1905, p. 276.

SWEET PEA.

Insects.

Aphids—See Pea.

White Fly—See Tomato.

Fungi.

Dampening Off—Rots off stem just below ground, causing vines to turn yellow and finally die. Plant in well drained soil; place well-rotted manure deep in ground below the seed; avoid excessive watering; spray base of vines and ground with Bordeaux; change beds if appearing yearly. Rept. 1907, p. 359.

SYCAMORE.

Fungi.

Anthracnose—Kills young leaves in the spring; causes dead areas of irregular shape in tissues of older ones often following veins. If thought advisable to spray, use Bordeaux on the leaves as soon as showing and repeat when half and full grown.

TOBACCO.

Insects.

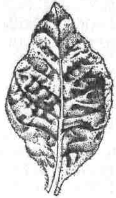
Tobacco or Tomato Horn-Worms—Large green caterpillars with horn on the tail devour the leaves. Practice hand picking or spray or dust the plants with lead arsenate. Rept. 1906, p. 269.

Flea Beetle—Adults eat holes through the leaves. Spray upper and under surface heavily with lead arsenate. Bull. 208, p. 103; Rept. 1906, p. 271.

Cut-Worms—See Tomato.

Wire-Worms—Occasionally destroy newly set plants under cloth by tunneling in the stems below the surface of the ground. Trap plants will attract the wire worms, which may be killed with cyanide before setting the main crop.

Fungi, etc.



Calico—Causes the leaves to becom regularly mottled with a lighter green c and makes a very inferior tobacco. quently infected leaves finally show nu ous, irregular, often merging, brown s known as "rust." While calico is a so-c physiological disease, it can be comm cated to a healthy plant through contact a very small amount of juice from a dise plant. Care, therefore, is necessary handling diseased plants in touching hea ones. Never use tobacco water or tobacco stems on the beds. If calico shows in a seed bed, pull up all suspi plants and those surrounding them. If troubled year year, sterilize the seed beds or change them, and never r them on land used for tobacco the year before. When t planting, wash the hands occasionally with soap and w Repts. 1898, p. 242; 1899, p. 252; 1914, p. 357; Bull. 166, p

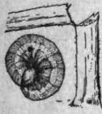
Dampening Off—Due to various fungi which rot of seedlings or their roots. Keep air of beds as dry as consi with good growth by care in watering and ventilating trouble starts in spots, take out all infected p and refuse there.

Black Root Rot—Shows in seed bed dwarfed "rosette" plants whose roots have largely rotted off. Frequently it does dama fields, especially where Havana has long cultivated, but Round Tip is little injure short rotation is advisable in bad cases. Ste seed beds with steam or treat with for (formula D). Repts. 1906, p. 342; 1907, p.

Wild Fire—Shows first in lower leaves as small, roundish, yellow spots. In time these grow larger, turn darker, and irregular dead areas appear more or less *prominently*. This disease is caused by bacteria and is favored by wet weather. It is carried on the seed and later may be readily transferred from infected places in the field by certain insects and the wind. Care should be used to select seed only from disease-free fields and sow this seed in sterilized seed bed. Where doubtful seed is used this should be soaked for 10 minutes in corrosive sublimate, rate of 1 to 1,000 parts water, stirring the seed during the treatment. Drain off the liquid, wash seed in pure water several times and dry before storing. Old cloth used previously on infected beds should be boiled in water before used again. Spray the beds, with Bordeaux mixture, shortly after the young plants have rooted, repeating every week until the setting season is over.

TOMATO.

Insects.



Cut-Worms—Eat off plant near ground or climb the plant and devour the leaves. Place around field poisoned bait or bran mash containing arsenic. Trap cut-worms with small piece of board. Rept. 1906, p. 264; Bulls. 190, p. 18; 208, p. 112; 216, p. 43.

Tomato or **Tobacco Horn-Worm**—See Tobacco.

Flea Beetle—See Potato or Tobacco.

Potato Aphid—See Potato.

Stalk Borer—See Dahlia.

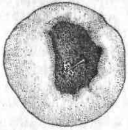
White Fly—Sucks the sap from under side of leaves. Spray under side of leaves with soap and water. Fumigate greenhouses with hydrocyanic acid gas (½ oz. to 1000 cubic ft.). Bulls. 140; 216, p. 50; Rept. 1902, p. 148.

Fungi, etc.

Bacterial Canker—Shows as small brownish streaks of d and collapsed tissue running down the sides of the stems; first may be concealed by the epidermis. The infected st with their leaves soon wither and die. Badly infected fi are sometimes worthless. First seen here in a limited in 1924, but was more frequent and serious the next y Use seed from healthy plants only, or if uncertain treat s If necessary make new seed beds. Practice rotation, especially avoid fields where disease has occurred.

Mosaic—Rept. 1908, p. 857. See Calico of Tobacco.

Leaf Spot—Produces on leaves and stems numerous, sm dark spots, often with white centers. Begin spraying Bordeaux about the middle of July, making 3 or 4 applicati at intervals of 10 to 14 days. This usually develops too in the season here to cause serious damage.



Point Rot—Causes the green fruit to at bloom end, showing a large, firm, d brown area. Claimed to be a physiolog trouble. Frequently bad in very dry sons. In greenhouses sub-irrigation is to prevent it. Spraying is of little va Considerable difference exists in varie as to susceptibility.

Scab—Occurs most commonly in greenhouses, cove under surface of leaves *more or less* abundantly with an ol brown growth which finally kills the tissue above. Sp with Bordeaux, picking ripe fruit before each of the treatments.

Wilt—Occurs here chiefly in greenhouses; plants turn low and slowly wither up; fungus may finally show on d

stem and fruit as pinkish growth. Caused by fungus clogging ducts and cutting off water supply to leaves; in young stage presence shown by blackened bundles where stems are cut across. Change soil if appearing yearly; do not sow seeds from infected plants, as they can carry the disease. Spraying of no value. Rept. 1903, p. 366.

TULIP TREE.

Insects.

Tulip Tree Scale—Large brown hemispherical soft scales on bark, sucking the sap, especially on lower branches. Spray with lime-sulphur when trees are dormant. Oils may cause injury. Rept. 1921, p. 176.

TURNIP-RUTABAGA.

Insects.

Cut-Worms—See Tomato.
Cabbage Maggot—See Cabbage.

Turnip Aphid—Green aphids on under side of leaves sucking the sap. Dust with nicotine. Repts. 1916, p. 98; 1922, p. 346.

Fungi, etc.

Club Root—See Cabbage.

Soft Rot—Causes an interior soft decay of roots, etc., of a variety of vegetables, such as turnips, salsify, parsnips, carrots, celery. Very wet seasons and imperfect storage conditions are usually the starting point of these troubles. Store under best possible conditions for keeping down heat and moisture. Keep contaminated refuse out of manure pile. Rept. 1914, p. 25.

Phoma Rot—Appears usually after storage, causing co[illegible] spicuous, dry, sunken, subcircular, black spots scattered o[illegible] roots. Fruiting pustules show as black dots. Store roots cool dry place and not too deeply in the piles. Practice yea[illegible] rotation and keep refuse from manure pile. If necessary, [illegible] only artificial fertilizers. Rept. 1912, p. 355.

VIOLET.

Insects, etc.

Violet Gall Midge—Larvae in curled edges of new leav[illegible] Fumigate every other night with hydrocyanic acid gas (½ [illegible] to 1000 cu. ft.) until galls disappear. Exposure not less t[illegible] two hours. Rept. 1921, p. 152.

Violet Sawfly—Larvae devour leaves. Spray with l[illegible] arsenate or hellebore.

Eelworms—Form galls on the roots. Plant in new soil [illegible] sterilize the old soil by steam. Add plenty of air-slaked li[illegible] to the soil. See Snapdragon.

Fungi.

Spot Disease—Shows as whitish round spots on the lea[illegible] Spray field plants early in fall with Bordeaux. Select o[illegible] best stock for greenhouse; remove *all* affected leaves be[illegible] transplanting. When plants have become established, sp[illegible] again with Bordeaux. Be careful about watering plants, [illegible] by proper ventilation and heat during September to Novem[illegible] keep atmosphere of house from ever becoming too moist.

WALNUT.

Insects.

Walnut Caterpillar—Clusters of black caterpillars cov[illegible] with whitish hairs strip the branches and finally the tree [illegible] August. Spray with lead arsenate. Clip off twigs when ca[illegible] pillars are small, and kill by crushing. Repts. 1914, p. [illegible] 1917, p. 326.

Walnut Weevil or **Curculio**—Adults feed at base of leaf stems. Larvae tunnel in new shoots and infest the fruit of Persian and Japanese walnuts. Spray with lead arsenate. Rept. 1912, p. 240.

Walnut Bud Moth—Larvae feed upon tender leaves and shoots, webbing them together. Spray with lead arsenate. Rept. 1912, p. 253.

WHEAT.

Insects.

Army Worm—See Grass.

Hessian Fly—Maggots burrow in sheath of a leaf at base of stem, causing the stalks to turn yellow and die. Plant late.

Wheat Midge—The fly lays eggs on the chaff and the maggots feed upon the developing kernels, so that the heads ripen early and produce no grain. Burn stubble before plowing. Plow infested fields deeply in the fall. Rept. 1917, p. 366.

Green Bug or **Aphid**—Green aphids suck the sap from leaves. Destroy in early fall all volunteer wheat and oats. Practice crop rotation.

Fungi.

Black Stem Rust—See Oats.

Leaf Rusts—Form small, dusty, orange-colored outbreaks on leaves, etc., and later darker and firmer mature stage. Several closely related species on barley, rye, and wheat but quite distinct from black stem rust. Some varieties are more resistant than others to these various grain rusts. No effective treatment.

into a dusty olive-black mass that is dissip[...] in time. Soak seed for 4 hours in cold water [...] treat, after standing in sacks 4 hours more, [...] 5 minutes in hot water at temperature of 133 [...] or use formalin (B) dry sprinkle. Dry t[...]oughly if stored.

Stinking Smut—Fills the apparently sca[...] changed seeds with a dusty mass of sp[...] Spores often found more or less abundantl[...] middlings and other feeds containing wheat, [...] their presence in amount indicates poor qu[...] and may have some connection with compl[...] of injury to stock fed on these. Use for[...] treatment. Rept. 1909-10, p. 736.

WILLOW.

Insects.

Fall Web Worm—See Pear.

Spiny Elm Caterpillar—See Elm.

Poplar Tent-Maker—See Poplar.

Poplar and **Willow Curculio**—See Poplar.

Sawflies—Larvae devour leaves. Spray with lead ars[...]

Imported Willow Leaf Beetle—Larvae and adults feed [...] the surface of the leaves of smooth-leafed species, soon [...]tonizing them. Spray with lead arsenate. Rept. 1921, p[...]

Aphids—Large reddish aphids congregate on twigs i[...] and suck the sap. Spray with kerosene emulsion or ni[...] solution and soap.

Oyster-Shell Scale—See Apple.

Fungi.

Rusts—Occur on the leaves; similar in appearanc[...] closely related to those on poplar. The alternate host f[...] species is the larch and apparently there is another the [...] nate host of which is not yet determined. Rept. 1915, [...]

MANUFACTURERS AND DEALERS IN SPRAY APPARATUS AND SUPPLIES.

Prospective purchasers should write to these firms for catalogues and prices.

MANUFACTURERS OF SPRAYING MACHINES.

Barnes Mfg. Co., The, Mansfield, Ohio. (Hand sprayers.)

Bateman Co., Fred. H., Grenloch, N. J. (Iron Age sprayers, traction and power.)

Bean Spray Pump Co., Lansing, Mich. (Hand and power sprayers and dusters.)

Brown Co., E. C., Rochester, N. Y. (Compressed air, hand and power outfits.)

Burch Plow Works Co., The, Crestline, Ohio. (Sprayers.)

Church, Stephen B., Seymour, Conn. (Power and hand sprayers.)

Church-Tyler Co., 210 Congress St., Boston, Mass. (Power and hand sprayers.)

Dayton Manufacturing Co., The, 2240 East Third St., Dayton, Ohio. (Hand sprayers.)

Deming Co., The, Salem, Ohio. (Hand and power pumps.)

Dobbins Bros. Mfg. Co., North St. Paul, Minn. (Hand dusters.)

Ellis Co., Wm. O., Concord Junction, Mass. (Spraying materials, Peerless Hand dusters.)

Field Force Pump Co., Elmira, N. Y. (Hand, traction and power spraying machines.)

Fitzhenry-Guptill Co., 135 First St., Cambridge, Mass. (Power sprayers.)

Friend Mfg. Co., Gasport, N. Y. (Spraying outfits, power and hand spray pumps and all sprayer accessories.)

Goulds Mfg. Co., 177 High St., Boston, Mass.; 16 Murray St., New Y (Hand and power sprayers.)

Hardie Mfg. Co., The, Hudson, Mich. Distributors: Brockport Spr and Pump Co., Brockport, N. Y.; H. V. Hart Co., Hagerstown, (Hand and power sprayers.)

Hayes Pump and Planter Co., Galva, Ill. (Spray pumps.)

Humphryes Mfg. Co., The, Mansfield, Ohio. (Hand and power pumps

Leggett & Brother, Inc., 301 Pearl St., New York. (Hand and p dusters and liquid sprayers, insecticides and fungicides.)

Lunt Jillson Co., The, Manchester, Conn.; 1 Washington St., Boston, M (Hand and power outfits.)

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Spramotor Co., 107-109 Erie St., Buffalo, N. Y. (Hand and power out

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Niagara Sprayer Co., Middleport, N. Y. (Dusting materials.)

Nicotine Production Corporation, Clarksville, Tenn. (Nicotine sulphate and free nicotine.)

Nitrate Agencies Company, Bayonne, N. J. (Manufacturers of agricultural insecticides and fungicides.)

Orchard and Garden Supply Co., The, Northampton, Mass. (Spray machinery and supplies.)

Pratt Company, B. G., 50 Church St., New York City. (Miscible oils.

Riches, Piver & Co., 30 Church St., New York City. (Agricultural ins cides and fungicides.)

Roessler & Hasslacher Chemical Co., The, 709 Sixth Ave., New York (Cyanegg, Formaldehyde, Copper Carbonate.)

Sherwin-Williams Co., The, 601 Canal Road, Cleveland, Ohio. (Insecti and fungicides.)

Standard Chemical Works, Inc., Reading, Pa. (Spray and dusting mater

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Tanglefoot Co., The, Grand Rapids, Mich. (New England Agents, Al Hall & Co., 12 So. Market St., Boston, Mass. Tanglefoot.)

Taylor Chemical Co., 8 W. 40th St., New York City. (Carbon di-sulph

Tobacco By-Products & Chemical Corporation, Inc., Louisville, Ky. (

tine solution.)

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Bedient, D. F., Ridgefield. (Spray materials.)

Benjamin, F. C., 132-6 White St., Danbury. (Spray apparatus, insecticides and fungicides.)

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Blish Hardware Co., F. T., So. Manchester. (Insecticides, fungicides and spray apparatus.)

Cadwell & Jones, Seedsmen, 1084 Main St., Hartford. (Pumps, insecticides and fungicides.)

Chandler & Morse, Putnam. (Spray apparatus, insecticides and fungicides.)

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Dudley, Frederick D., North Haven. (Spray and dust materials.)

Eaton Chase Co., The, 129 Main St., Norwich. (Spray apparatus insecticides.)

Fairfield Hardware Store, Fairfield. (Spray materials.)

Gilman, Alexander & Co., Inc., Putnam. (Spray apparatus, insecticide fungicides.)

Grasselli Chemical Co., 46 River St., New Haven. (Insecticides and f cides.)

Greenwich Hardware Co., Greenwich. (Spray materials.)

Henry & Son, W. A., Blue Hills Farm, Wallingford. (Insecticide fungicides.)

Hurd & Burr, Shelton. (Spray materials.)

Jackson-Marvin Hardware Co., 843-849 Whalley Ave., New Haven. (ticides and fungicides.)

Jordan Hardware Co., The, Willimantic. (Spray apparatus, insec and fungicides.)

Judson Company, The Dwight R., 237 State St., Hartford. (Insec and fungicides.)

Krenz, Ludwig, 544 Main St., Middletown. (Insecticides, fungicides, spray apparatus.)

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Leete Co., The Chas. S., 299 State St., New Haven. (Wholesale Druggists. Insecticides, fungicides and spray materials.)

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Platt Co., The Frank S., 450 State St., New Haven. (Pumps, insecti and fungicides.)

Rackliffe Bros. Co., Inc., Park and *Bigelow Sts.*, New *Britain*. (S materials.)

Redford, George E., 494 Main St., Middletown. (Insecticides, fungi spray apparatus.)

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BULLETIN 272 DECEMBER, 1925

Connecticut Agricultural Experiment Station

New Haven, Connecticut

Report on Commercial Insecticides and Fungicides 1925

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December, 1925

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THE TUTTLE, MOREHOUSE & TAYLOR COMPANY

Examination of Insecticides, Fungicides, Etc.

E. M. Bailey*

INTRODUCTION.

The Legislature of 1923 passed an act concerning the manufacture, sale and transportation of adulterated insecticides and fungicides. The text of the law and regulations, made as provided therein for its enforcement, are given in Bulletin 258 issued by the station in 1924. Both the law and such regulations as have been made are substantially the same as the federal law and regulations so that articles of this class which satisfy the requirements of interstate commerce will be accepted in this State.

The law requires this station to make analyses of samples which may be collected by the Dairy Commissioner or by our station agent. Evidence of adulteration or misbranding is required to be reported to the Dairy Commissioner who is responsible for enforcement of the law. Analyses and such other information regarding the character, composition and use of these materials as may be of interest are required to be published in bulletins of this station, either annually or at other intervals as may be advisable. The law carries no specific appropriation for the inspection work and a complete survey of the entire field of insecticides and fungicides each year is not thought to be advisable or necessary.

During the past year our agent has collected samples of lead arsenate and other arsenicals, and miscellaneous materials; examinations have been made also of products submitted from time to time by the Department of Entomology, and the Department of Botany of this station.

CLASSIFICATION OF MATERIALS.

The samples analyzed may be classified as follows:

Materials	No. of samples
Lead Arsenate	15
Bordeaux-Lead Mixtures	5
Sulphur Preparations	6
Nicotine Preparations	7
Emulsions	3
Miscellaneous (including A. O. A. C. collaborative samples)	13

* Analytical data are by Messrs. Andrew and Fisher. Inspection and sampling by Mr. Churchill.

METHODS OF ANALYSIS.

The methods of analysis employed are those authorized by the Association of Official Agricultural Chemists unless otherwise stated.

RESULTS OF INSPECTION AND ANALYSIS.

Arsenate of Lead.

The specifications for arsenate of lead as defined in the law of this State are the same as those required by the Federal Insecticide Act.

Dry arsenate of lead must contain not less than twenty-five per cent of total arsenic oxide (As_2O_5), and arsenic in water-soluble forms not exceeding one and one-half per cent.

Arsenate of lead, not dry or powdered, may contain not more than fifty per cent of water; not more than seventy-five one-hundredths per cent of arsenic in water-soluble forms, expressed as arsenic oxide (As_2O_5); and not less than twelve and one-half per cent of total arsenic oxide (As_2O_5).

Analyses of the products examined are given in Table I.

TABLE I. *Analyses of Arsenate of Lead.*

Station No.	Brand, Manufacturer or Distributor.	Water. Found.	Water. Guaranteed not more than.	Arsenic Oxide, As_2O_5 Total. Found.	Arsenic Oxide, As_2O_5 Total. Guaranteed not less than.	Arsenic Oxide, As_2O_5 Water-Soluble. Found.	Arsenic Oxide, As_2O_5 Water-Soluble. Guaranteed not more than.	Lead-Oxide, PbO. Found.	Lead-Oxide, PbO. Guaranteed not less than.	Station No.
	Sampled by Station Agent.	%	%	%	%	%	%	%	%	
2479	Bowker's Insecticide Co., New York. *Bowker*	49.45	50.00	15.60	15.00	0.09	0.60	32.37	....	2479
2480	Chipman Chemical Eng. Co., New York. *Chipman*	....	....	31.10	30.00	0.23	1.07[1]	63.80	....	2480
2483	Chipman Chemical Eng. Co., New York. *Chipman*	....	....	30.89	30.00	0.18	1.07[1]	64.10	....	2483
2474	Grasselli Chem. Co., New York	....	....	31.32	31.00	0.18	1.15[1]	61.15	....	2474
2478	Grasselli Chem. Co., New York	....	....	30.67	31.00	0.14	1.15[1]	64.15	....	2478
2477	Interstate Chem. Co., Jersey City, N. J. *Key-Dry*	....	....	30.02	30.00	0.18	0.75	64.50	....	2477
2484	The Kil-tone Company, Vineland, N. J.	....	....	30.24	30.00	0.18	1.15[1]	63.55	....	2484
2464	Niagara Sprayer Co., Middleport, N. Y. *Niagara*	....	....	31.54	30.00	0.18	1.15[1]	64.35	....	2464
2470	Nitrate Agencies Co., New York. *Naco*	....	....	30.24	30.00	0.37	1.00	65.95	62.00	2470
2525	Pittsburgh Plate Glass Co., Newark, N. J. *Corona Dry*	....	....	31.86	....	0.14	...	65.65	....	2525
2471	Riches Piver & Co., New York	35.17	50.00	20.02	15.00	0.18	0.50	41.80	31.00	2471
2473	Sherwin-Williams Co., Cleveland, Ohio	....	....	31.86	30.00	0.18	1.00	65.00	....	2473
2472	D. B. Smith & Co., Utica, N. Y. *Lightening*	....	....	31.05	30.00	0.18	0.77[1]	63.30	....	2472
	Sampled by Purchaser or Manufacturer.									
2482	Vreeland Chemical Mfg. Co., Little Falls, N. Y. *Electro.* Mfr's sample	....	....	30.24	30.00	0.18	0.77[1]	64.40	....	2482
2390	G. A. Clyne, Waterbury. Purchaser's sample	....	....	....	....	0.11	...	....	....	2390

[1] Calculated from amount guaranteed as metallic arsenic.

Bordeaux-Lead Arsenate, etc.

2465. *Pyrox.* Bowker Chemical Co., New York.

2467. *Bordo-Lead.* Chipman Chemical and Engineering Co., New York.

2481. *Bordo-Arsenate.* Glidden Co., Cleveland, Ohio.

2468. *Hexpo.* H. J. Smith Co., Utica, N. Y.

2466. *Bordo-Lead Mixture.* Vreeland Chemical Mfg. Co., New York.

Analyses are given in Table II.

Table II. *Analyses of Bordeaux-Lead Arsenate, etc.*

No.	Condition.	Water.	Arsenic Oxide, As_2O_5. Total. Found.	Total. Guaranteed, not less than.	Water-Soluble. Found.	Water-Soluble. Guaranteed, not more than.	Copper Oxide, CuO.	Lead Oxide, PbO.
		%	%	%	%	%	%	%
2465	Paste	65.95	5.57	5.00[1]	0.06	0.46[1]	8.39	1.28
2467	Dry	....	8.73	7.29[1]	0.18	0.38[1]	20.62	15.24
2481	Dry	....	14.77	5.90	0.18	0.50[1]	16.66	26.64
2468	Dry	....	8.37	6.90	0.28	0.50[1]	22.62	18.89
2466	Paste	44.23	8.91	5.58	0.11	0.78[1]	3.22	18.32

[1] Calculated from amount guaranteed as metallic arsenic.

Sulphur Preparations.

2506. *Sulfocide.* B. S. Pratt Co., New York. This product was labeled: Sodium polysulphide 39-40 per cent; sodium thiosulphate 1-2 per cent; inert ingredients 58-60 per cent.

Analysis showed the following composition:

Total sulphur	33.78	per cent
Sulphur as monosulphide	7.79	" "
Sulphur as thiosulphate	2.56	" "
Sulphur as sulphate	0.25	" "
Polysulphide sulphur (by difference)	23.18	" "
Equivalent to sodium polysulphide	38.48	" "

Sodium polysulphide is assumed to be the pentasulphide in the above calculation.

2518. *Niagara Pomodust.* Niagara Sprayer Co., Middleport, N. Y. The active ingredients claimed are sulphur not less than 87 per cent; arsenic (metallic), not less than 1.76 per cent; arsenic, water-soluble (metallic), not more than 0.50 per cent.

Analysis showed the following:

Total arsenic (metallic)	1.84	per cent
Water soluble arsenic (metallic)	0.12	" "
Total sulphur	89.73	" "

22695. *Sulphur-Arsenate Dust* 90-10; and **22696**, *Sulphur-Arsenate Dust* 83-15. John Bacon, Gasport, N. Y.

Analyses were made as follows:

	22695		22696	
	Found.	Guaranteed.	Found.	Guaranteed.
	%	%	%	%
Total arsenic as As_2O_5	2.85	....	3.74	....
as As	1.86	1.90	2.44	2.80
Water sol. arsenic as As_2O_5	0.17	....	0.22	....
as As	0.11	0.10	0.14	0.15
Total sulphur[1]	88.27	88.50	84.75	83.00

[1] Sulphur determined by the U. S. P. method IX, and sulphur in the undissolved residue by the A. O. A. C. method, Sec. 19, p. 20.

2551. *Sulphur Dust.* Sample submitted by Department of Entomology and examined for presence of lead arsenate. Qualitative tests showed presence of both arsenic and lead.

1855. *Lime-sulphur.* (Blanchard's). **1856.** Grasselli's. Samples were submitted by a purchaser and the following determinations were made.

	No. 1855	No. 1856
	%	%
Specific gravity at 22° C.	1.2333	1.3080
Baumé degrees	27.4	34.10
Total sulphur	19.62	26.35

Nicotine Preparations.

2476. *Black Leaf 40.* Tobacco By-Products and Chemical Corporation, Louisville, Ky. Active ingredient nicotine, 40 per cent. Nicotine found 40.93 per cent.

2517. *Niagara A 1 Dust.* Niagara Sprayer Co., Middleport, N. Y. Claimed to contain 2.7 per cent of nicotine. Nicotine found 2.78 per cent.

2469. *Hall's Nicotine Sulphate Solution,* 40 per cent nicotine. Hall Tobacco Chemical Co., St. Louis, Mo. Nicotine found 40.61 per cent.

2919. *Nico Fume* (Liquid). Tobacco By-Products and Chemical Corporation, Inc., Louisville, Ky. Claimed to contain 40 per cent free nicotine. The product contained 42.90 per cent.

2920. *Nico Fume* Tobacco Powder. Tobacco By-Products and Chemical Corporation, Inc., Louisville, Ky. This product was guaranteed to contain 12.5 per cent nicotine and the package was dated to indicate the time after which the above guaranty would not hold. The sample was purchased after the expiration of the period indicated, but attention was called to that fact by the dealer and the article was sold at a reduced price. The nicotine

found was 12.71 per cent, indicating that the precaution on the label gave the manufacturer an ample margin of safety.

22371. *Tobacco Dust.* Submitted by E. M. Ives, Meriden.

Analysis:

Nicotine found	0.71%
Passed 200 mesh	96.00%

1300. Nicotine Dust. (Old Sample.) Submitted by Department of Entomology.

Analysis: Nicotine found 1.96%

Spray Emulsions.

1465. *Soluble Spray Oil* for dormant spraying. Clarkson & Ford, New York. Sample submitted by the Lyman Farm, Middlefield, Conn.

Partial analysis was made as follows:

	%
Specific gravity 25° C.	0.9333
Unsaponifiable	85.10
Rosin	present

The mixture is a light petroleum oil containing a sodium soap, probably sodium rosinate.

2507. *Pratt's Carboleine.* B. G. Pratt, 50 Church St., N. Y. Sample submitted by the Department of Entomology of this Station.

Analysis	Found. %	Guaranteed. %
Oil	88.74	86.00
Phenol	present	3.00
Ash	1.22	....
Water, determined by xylol, 11.17, by difference	10.04	....

The product was claimed to contain 83 per cent mineral oil and 3 per cent saponifiable oil. Potassium oxide was claimed to be 1 per cent.

2508. *Anthracine Oil Emulsion.* The Sherwin-Williams Co. Sample submitted by Department of Entomology. Claimed to contain anthracene oil 75 per cent, fish oil soap 3 per cent, water 22 per cent.

Analysis:

Total oil	72.63 per cent
*Water (xylol method)	25.08 " "
Soap and undetermined	2.29 " "

MISCELLANEOUS.

2475. *Kayso.* Golden State Sales Corp., New York.

Analysis:

Nitrogen	3.30%
Casein (N x 6.38)	21.05
Lime (CaO)	44.32

1600. *Lead arsenate* coated with lead stearate for experimental purposes (by Department of Entomology) was found not to have increased in water-soluble arsenic during the period of one year. At the two intervals the results for water-soluble arsenic (as As_2O_5) found were 0.09 in both cases.

2514. *Calcium Fluosilicate Compound.* Victor Chemical Works, New York. Submitted by Department of Entomology. Claimed to contain calcium fluosilicate not less than 15 per cent and inert ingredients not over 85 per cent.

Partial analysis was made as follows:

Phosphorus pentoxide (P_2O_5)	28.37%
Calcium oxide (CaO)	21.80
Iron and aluminum oxides ($Al_2O_3Fe_2O_3$)	20.60
Silica (SiO_2)	11.00
Flourine (F)	11.95

2505. *Atlas "A" Weed Killer.* Chipman Chemical Co., New York. Labelled as containing 45 per cent of sodium arsenite equivalent to 4 pounds arsenic trioxide per gallon.

Analysis:

Total arsenic found (as metallic)	23.67%
Calc. as sodium arsenite (Na_2HAsO_3)	53.64

23420, 23421, 23422, 23423 and **23426.** Experimental mixtures examined for the Department of Entomology.

Water-soluble arsenic only was determined.

2591 and **2592,** *Fish Oil Soaps;* and **2593** and **2594,** Engine oil emulsion and Kerosene emulsion respectively. These were examined in collaboration with the A. O. A. C. referee's program for study of methods of analysis.

The results obtained are reported elsewhere[1] but they are summarized here for reference.

	2591	2592
	%	%
Water, Xylol method	29.95	32.66
	29.96	32.49
Official method	30.00	32.06
	29.92	32.08

[1] Proceedings, A. O. A. C. 1925.

	2593	2594
	%	%
Ash	1.04	0.29
	1.08	0.28
Water (xylol method)	33.22	36.71
	33.28	36.93
Total Oil	65.26	63.40
	65.90	62.70
Potash (K_2O)	0.63	....
	0.65	....
Soda (Na_2O)	....	0.14
	....	0.15

Bulletin 273 January, 1926

Connecticut Agricultural Experiment Station
New Haven, Connecticut

CROSSED CORN

D. F. JONES
P. C. MANGELSDORF

The Bulletins of this Station are mailed free to citizens of Connecticut who apply for them, and to other applicants as far as the editions permit.

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January, 1926

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CROSSED CORN

D. F. Jones and P. C. Mangelsdorf.

Vigorous, sturdy plants, a good sound ear on every stalk, no weak and spindling plants, few nubbins or moldy ears. These are some of the outstanding characteristics of crossed corn. It is all these desirable features combined that enable this new kind of corn to outyield the old standard varieties, year after year, and under all sorts of conditions.

Crossing two distinct types of animals or of plants almost always causes an increase in vigor. This has long been known and used in the production of mules, sterile hybrids of the horse and the ass. Swine breeders often utilize the beneficial effects of hybrid vigor by crossing different breeds of pigs, feeding for market the hybrid offspring but not breeding from them.

The same principle can be used in increasing the yield of corn and the Connecticut Agricultural Experiment Station has been working for many years to find the best methods of utilizing hybrid vigor and to produce strains of corn for crossing that give high yields adapted to the cultural and market requirements of this region.

Several promising types of crossed corn have now been produced, of which stock seed is available for seed growing. Other types are now being developed to meet different requirements and these will soon be available for distribution.

The uniform production from every plant, though the most important feature, is only one of the desirable characteristics of crossed corn. The ears are more even in size and shape, there are fewer nubbins, poorly developed ears and moldy corn. Many combinations show appreciably less smut and root rot infection. The stalks themselves are sturdy and strong and stand up when other plants are laid low by wind and rain. In time of tasseling and silking the crossed plants are far more even than ordinary varieties and in ripening there is the same remarkable uniformity.

In crossed sweet corn this uniformity in time of ripening is a very valuable feature for the market gardener or canner. It enables the grower to harvest his crop at one time and have practically all of the ears ready to be picked. This results in a better quality of canned or table corn, because fewer immature and over-ripe ears are included.

The uniform size of the ears is also particularly desirable in the case of sweet corn. It makes for a more attractive product and is a feature that appeals especially to the restaurant trade.

SEED SELECTION.

The uniformity of crossed corn, its evenness in ripening, its increased productiveness, the greater freedom from disease, cannot be obtained by any of the usual methods of seed selection in naturally-pollinated fields of corn.

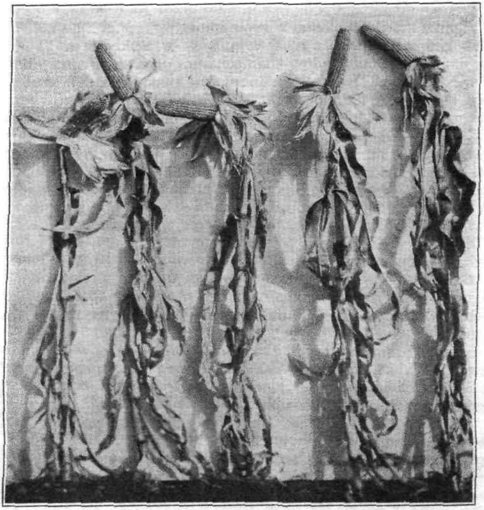


FIG. 1.—Vigorous, sturdy plants with a good ear on every stalk are characteristic of crossed corn.

One may go through a field or crib of corn, picking out the largest and finest ears, discarding all poorly filled and moldy ears and keeping only the one best ear out of every thousand, and yet these choice specimens do not reproduce their excellence; they do not "breed true." No matter how fine in appearance are the ears which are planted, they always give many weak plants and non-producers.

The failure of the finest ears to reproduce themselves has several causes. It is due, in part, to the fact that many of the best

ears are good, not because of their heredity but because of the especially favorable situation in which they grew. It is solely

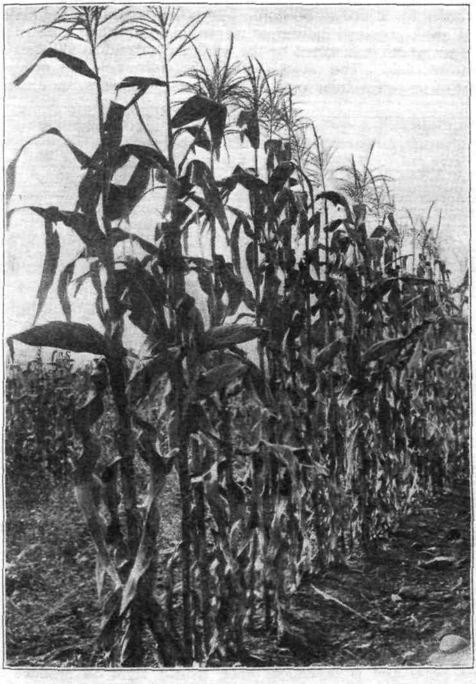


FIG. 2.—In size and shape of ear and in time of ripening there is a remarkable *uniformity*.

their environment that has made them better than the average and the effects of environment, we now know, can not be passed on to later generations.

The main reason, however, that the selected ears do not breed true lies in the fact that the pollen which produced their seeds came from all sorts of plants. Every silk must receive pollen in order for a seed to develop. The pollen is shed by the tassels and good, poor and indifferent plants alike send their pollen into the air where it is mixed by the wind and carried to all parts of the corn field. The choicest ear in the entire field has received part of its pollen from some of the poorest neighbors.

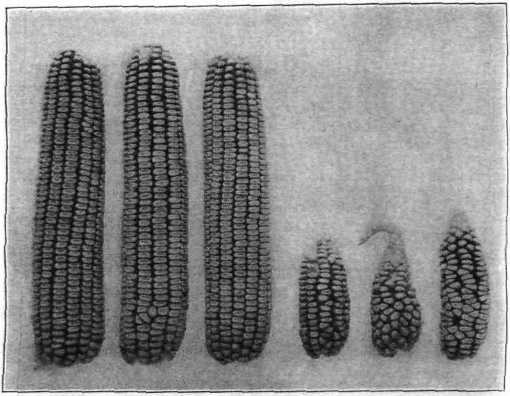


FIG. 3.—The plants grown from the small ears were just as large and the yield of shelled grain was the same as from the large seed ears.

This constant inter-crossing and hereditary mixing going on in every corn field has brought about a condition whereby every plant is a hybrid of greater or less degree of complexity and the offspring of hybrids are usually diverse and seldom like their parents. Moreover, corn has been naturally crossed in this way for countless years and is dependent upon hybrid vigor to produce its largest yield.

In spite of the natural crossing which is constantly going on, it is possible by ordinary field selection, patiently practiced, year after year, to bring about an improvement in certain respects. By saving for seed only the ears from the earliest ripening plants one may in time develop a variety that will mature somewhat

earlier. By choosing plants with many ears, the average number of ears per stalk can be gradually increased. Noticeable changes can be made in the number of rows of grain on the ear, the size and shape of the ear or the type of kernel.

Selection of this kind is usually made with some definite aim of adapting the variety more perfectly to the purpose for which it is grown. Such alterations are seldom accompanied by any increase of yield and often, particularly where extreme earliness is sought, productiveness is lowered.

Tests carried out at many places have shown that the prize winning ears at the corn shows often yield no more than unselected ears that are much less desirable in appearance. This fact is brought out in the accompanying illustration. Plants grown from the nubbins at the right were just as strong as those produced by the good ears shown on the left. The ears were fully as large and the yield of shelled corn was exactly the same.

In this case the difference in appearance of the two lots of seed ears was not due to heredity but merely to the conditions in the field in which they grew, the one in a good situation, the other in a poor one.

THE EAR-TO-ROW METHOD OF SELECTION.

When the seed from a number of ears of corn are planted separately, each in a row by itself, some lots grow better and yield considerably more than others. It was formerly thought that by selecting seed from the high producing rows or planting the remaining seed from the best yielding mother ears, and continuing this process from year to year, an increase in yield could be obtained. A marked increase in yield is sometimes obtained the first year or two but extensive tests have shown that the differences are not permanent and that in later generations the yield from the originally high producers is no more than that obtained from the unselected seed.

The failure of the high producing ears to maintain their increased yields is probably due to their hybrid composition. They split up and lose vigor in later generations. Selection towards a single type also brings about a certain amount of inbreeding which always weakens the plants.

HYBRID VIGOR.

Crossing somewhat different but related forms of plants or animals results in greater growth, the offspring often being better than either parent. Blue-gray cattle have long been used for beef in Scotland. They are the result of crossing a white Shorthorn bull and black Galloway or Angus cows. The large growth,

early maturity and fine beef quality has given this breed cross an enviable reputation whereever beef cattle are raised.

The Carolina poplar is a thrifty, fast-growing tree that succeeds well in nearly all parts of the country. It is considered to be a

Fig. 4.—Two dwarf types of corn give an astonishing result when crossed.

natural hybrid between the Cottonwood of our western plains and the European Black poplar. A valuable feature of this tree is the ease with which it can be grown from cuttings. Its vigorous nature is thus easily maintained while at the same time the trees are multiplied in numbers.

Hybrid vigor is usually responsible for part of the value of most vegetatively propagated plants. As long as they are not

reproduced from seeds the stimulus to increased growth is maintained undiminished. In naturally cross-pollinated plants it is necessary to keep up a constant intercrossing in order to maintain full vigor.

The corn plant is so constructed with its tassel, the pollen-bearing structure, at the top of the stalk, that it can be easily detasseled before pollen is shed, thereby entirely preventing self-fertilization. Fifty years ago a method was outlined whereby two varieties of corn could be crossed by planting them in alternat-

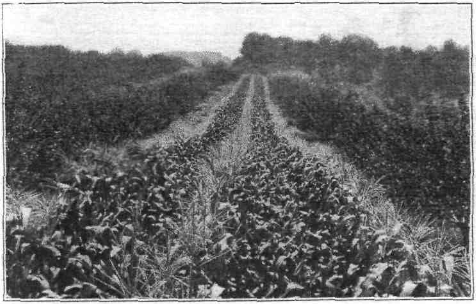


FIG. 5.—The corn plant is so constructed that it can easily be crossed by planting in alternating rows and detasseling all of the plants of one kind before pollen is shed.

ing rows and pulling out all the tassels of one variety before pollen is shed. All of the seeds borne on such emasculated plants must result from cross-pollination of one variety with another.

Numerous tests have shown that an increased yield often results when certain varieties of different type, such as flint and dent, are crossed. Some varieties of corn from China when crossed with native varieties have given considerably larger yields than either parent. Crossing an early variety with a late variety sometimes gives a cross-bred progeny that yields as much as the later parent and is appreciably earlier. Varieties of similar type when combined have not given much better results than either parent.

The increased yields which are obtained come only the first year after crossing. To get the benefit of hybrid vigor in plants reproduced by seeds it is necessary to make the cross each year and plant only the crossed seed. Any improvement in yield or

in other respects must be great enough to repay the extra cost of producing seed in this way. Variety crosses, while better than their parental stocks in some cases, have not, apparently, offered sufficient improvement to induce corn growers to make a practical application of this method.

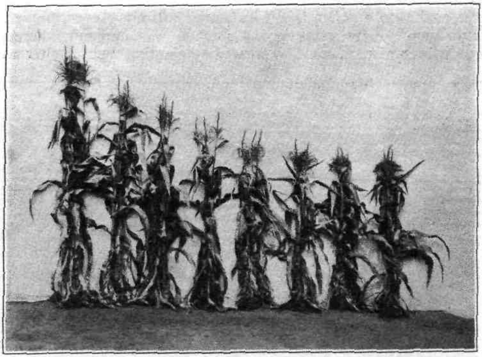


FIG. 6.—The result of seven generations of inbreeding.

INBREEDING BEFORE CROSSING.

A larger increase in yield together with a much greater uniformity and fixity of type is obtained by first inbreeding corn by artificial hand pollination for several years and then crossing two different inbred strains. This is shown in the accompanying illustration. A variety of Leaming which yielded 96 bushels per acre was inbred, that is, the silks were artificially pollinated with pollen from the same plants. After five years of inbreeding two strains, one of which had been reduced in yield to 32 bushels per acre, the other to 20 bushels, were crossed. The first generation cross of these two low yielding, inbred strains produced 115 bushels, an increase of twenty per cent over the original variety, under the same conditions. Not only did this hybrid exceed the original variety by twenty per cent in yield but the corn was of better quality. The ears were all closely alike in size and shape and all matured at practically the same time. Every stalk bore a good ear and there were fewer moldy ears, nubbins and less soft corn.

Here is a marked improvement secured by crossing. Unfortunately this particular cross and many other combinations made in the early years of these experiments were not well adapted to Connecticut conditions. The plants ripened too late to make a satisfactory corn for husking and the stalks were not large enough to make a good silage variety. Also the low yields and poor quality of the inbred strains made it practically impossible to produce crossed seed in quantity and at a price that would justify its use.

At the present time every effort is being made at this station and throughout the corn-growing states to produce inbred strains that

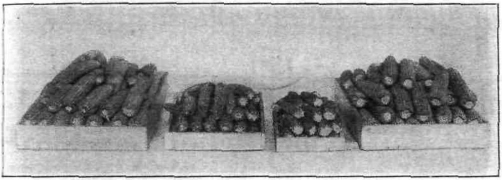


FIG. 7.—The two inbred strains were derived from the variety on the left and gave the result on the right when crossed—115 bushels per acre.

will give hybrid combinations well adapted to the local needs and which will be themselves sufficiently vigorous and productive to make the growing of crossed seed commercially profitable. Other methods of utilizing inbred strains of corn are being developed.

Crossed corn seed has now been grown in Connecticut five years and tested long enough to show its possibilities. Two crosses of inbred strains outyielded all varieties in the Iowa corn yield contest in 1924 in the south central section. One of the inbred strains used in one of these crosses was developed at this station.

A combination of four inbred strains known as Double Crossed Burr-Leaming has been tested for five years in comparison with the highest yielding varieties grown in this part of the country with the following results:

	Bushels of shelled corn per acre					
Highest Yielding Varieties	1918	1919	1920	1921	1922	Average
D. C. Burr-Leaming	116	88	55	95	63	83
Beardsley's Leaming	96	54	51	85	48	67
Luce's Favorite	..	79	38	81	50	62
Webber's Dent	81	62	57	73	49	64
Northern White Dent ..	84	75	32	87	..	69
Century Dent	68	51	55	77	67	64

FIG. 8.—The uniform production of a good ear from every stalk gives high yields.

FIG. 9.—Double Crossed Burr-Leaming grown at Durham, Connecticut.

Double Crossed Burr-Leaming has been grown in many other parts of the state and in various places in the corn-growing districts

south and west. In most cases it has out-yielded all other varieties, the stalks have stood erect in the fields until harvest and the leaves have remained green until the ears are well glazed.

A cross of two inbred strains of sweet corn grown for canning has yielded six tons of ears per acre in comparison with three and one-half tons from Evergreen corn.

FIG. 10.—Weak golden colored plants when crossed with dwarfs give all tall and vigorous progeny.

WHAT INBREEDING DOES.

Many abnormal or freak types of corn are known, such as dwarf plants, golden plants, which lack the normal green coloring matter necessary to manufacture food, liguleless plants, with upright instead of spreading leaves, and other characters which seriously weaken the plants and reduce their ability to produce grain. These abnormalities are inherited and pure breeding strains can be maintained from year to year.

When one of these unusual types is crossed with a normal plant only normal plants are produced in the first generation but the abnormality reappears in the second generation and may be recovered and made to breed true again, showing that these weakening characters are hereditary.

When, for example, a golden-leaved, liguleless plant is crossed with a dwarf form there result in the first following generation only vigorous, tall growing, dark green plants with spreading

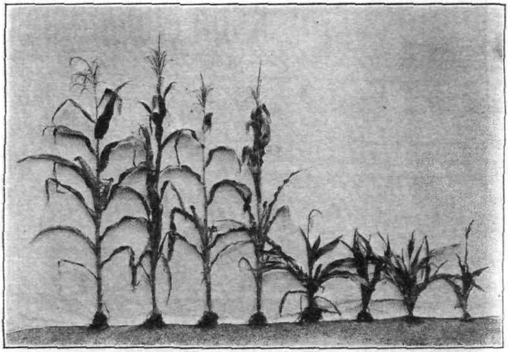


FIG. 11.—The second generation from the cross of golden, liguleless and dwarf. Eight different combinations of these characters are obtained.

leaves, all normal in every respect, uniformly vigorous and productive as shown in Figure 10.

Self-fertilizing these plants or allowing them to inter-pollinate gives an astonishing medley of plants in the next generation. There will be dwarf plants, golden plants and liguleless-leaved plants and some with two and even three of these abnormal characters combined in one individual. There will be some plants that are normal in all characters but very few will be as vigorous or productive as the first crossed plants.

The difference between the first and the second generation in respect to uniformity, size and productiveness is a very striking illustration of the bad effects of inbreeding. This is an extreme example but the same principle holds with naturally cross-fertilized

plants and with bisexual animals. In most cultivated plants such clear-cut abnormalities are not involved.

When any ordinary variety of corn is self-pollinated there is a noticeable reduction in size and yield and this usually continues for five or six generations. From this point on there is seldom

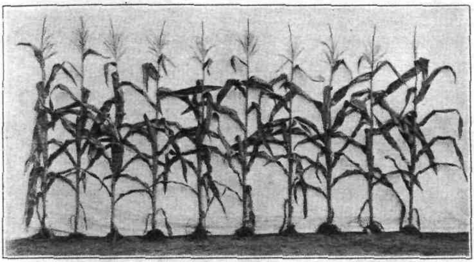


FIG. 12.—The descendants of a single plant after four generations of self-fertilization.

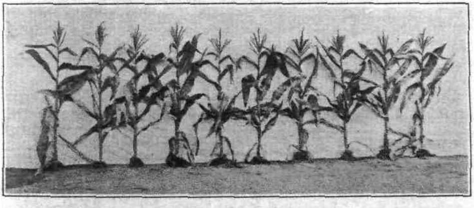


FIG. 13.—The plants within an inbred line are all closely alike but differ from every other line.

any further reduction. The plants in these generations, in any one strain, come to be all closely alike and remain fixed in their type from then on as long as they are not outcrossed to plants of different ancestry.

Every inbred strain descending from individual plants at the start is different to a greater or less extent from every other strain even though they all come from the same variety. Some are tall, others short. In color of leaves, silks and glumes, great

diversity is found and in the size and shape of the ears, time of ripening, ability to stand erect and in number and size of tillers there is marked dissimilarity. Productiveness ranges all the way from little or nothing up to a fair yield for inbred plants but no

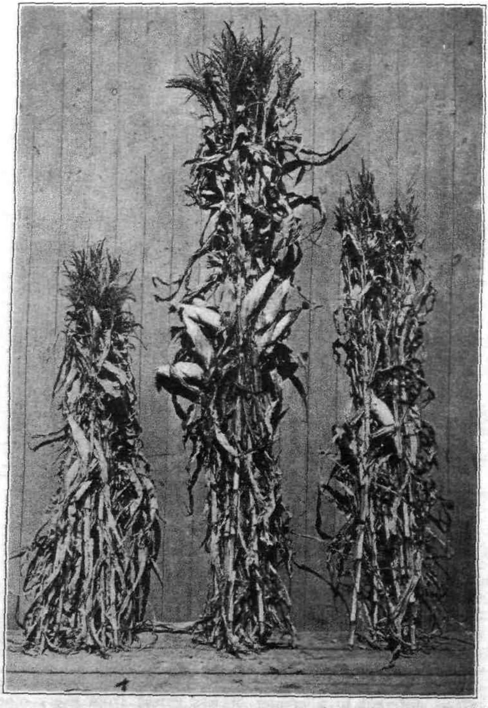


FIG. 14.—*Crossing inbred strains immediately restores vigor and productiveness.*

inbred strains have been obtained which are as productive as the original variety and usually the yields are reduced to less than half and the size of the seed and quality of the grain are proportionately lowered.

Since all of the plants within an inbred line come to be closely alike it makes no difference from that point on whether the plants are self-fertilized or are allowed to inter-cross among themselves. Their size and productiveness remain the same as long as pollen from all other kinds of corn is kept away from them.

When an inbred strain is crossed with another strain from the

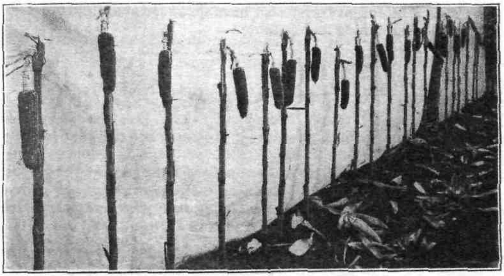


FIG. 15.—When rightly grown, crossed corn has no barren stalks or poor producers.

same or different variety there is a very great increase in size and yield in the next generation as we have already seen. In size the crossed plants are as large or larger than the original variety and in yield of grain they are often superior.

This is due apparently to the fact that the good qualities of both parents are expressed in the offspring while the weak qualities are covered over for the time being. Thus in the cross of golden, liguleless with dwarf the offspring are normal in every respect. The yellow foliage color, the upright posture of the leaves and the dwarfness of the stalk are all suppressed in this generation. What one parent lacks is supplied by the other, and conversely. Hybrid vigor seems to be a wise provision on the part of nature to enable the offspring to make the best of bad ancestry.

While most of the inbred strains do not have freak characters they are all lacking something which makes for full size and productiveness. Crossing any two strains usually brings back suffi-

cient vigor to make the plants as productive as the original variety while certain combinations are very much superior.

The greater production of crosses of inbred strains is not due so much to the large size of the ears as to the fact that every plant, if given an equal opportunity to grow, produces a good ear. Some of the ears of the original variety may be larger and finer than any produced by the hybrid but for every plant of this kind there are many stalks that have only nubbins and even some that are entirely barren.

The uniform production of an average good ear from every plant is largely responsible for the high yield of crossed corn. The even size and maturity also have distinct value in sweet corn for market gardening and canning.

HYBRID VIGOR NOT PERMANENT.

These desirable results are obtained only the first year after crossing. The second generation grown from the fine looking hybrid ears fall off in yield about 20 per cent as a general rule. While the amount of reduction may differ greatly this result always follows when hybrid corn, no matter how vigorous it may be, is used again for seed. This holds true whether the crossed plants are self-fertilized artificially or are allowed to inter-pollinate naturally.

A cross of two inbred strains grown six years averaged 101 bushels per acre. The second generation of this cross from self-pollinated first generation plants grown the same years and compared under equal conditions gave an average of 69 bushels, a decrease of more than 30 per cent.

The Nebraska Station compared the first and second generations of eight hybrid combinations during two seasons and obtained an average of 52.2 and 27.8 bushels per acre respectively for the two successive generations. The original variety from which the inbred strains were derived gave 41.7 bushels in the same period. In this case the reduction in yield from the first to the second generation is nearly 50 per cent. The second generation was grown from seed produced by inter-pollinating the first generation plants.

Not only is there this decided decrease in yield but uniformity is also lost. In size and shape of ear, height of plant and in time of ripening the second generation is even more variable than ordinary varieties.

If the second generation is again inbred the whole story of the production of inbred strains is repeated. There is a continued decrease in size and yield, as in the first period of inbreeding, and the reduction continues for about the same number of generations,

five to seven on the average, until uniformity and constancy are again reached. The inbred plants are generally no more vigorous than those of the previous inbreeding although they differ from their parental strains and from each other in minor characteristics.

In other words hybrid vigor is a transitory effect and ordinarily can not be fixed and made permanent except in plants propagated vegetatively. Varieties of fruits, vegetables and flowers that are reproduced by tubers, roots, grafts or other asexual methods of propagation owe their value to a superior combination of hereditary factors which produce the qualities desired and which also give plants a large amount of hybrid vigor. This is shown by their seedlings which are almost invariably weaker and poorer in many respects.

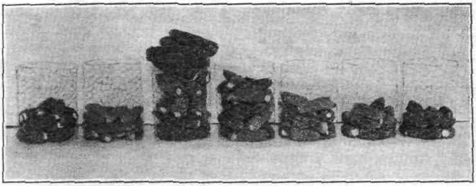


FIG. 16.—The first generation cross of two inbred strains will not continue to give as satisfactory results the next year. If inbred it will decline in vigor as in the first period of inbreeding.

Unfortunately from the standpoint of utilizing hybrid vigor, corn can not be reproduced in any way except by seeds. It can, however, be easily crossed. For that reason it is feasible to produce crossed seed for planting each year and grow only the first generation hybrid plants for production of sweet corn ears, grain or silage.

The additional cost of crossed seed is more easily justified for corn than for other crops because the cost of seed is a smaller item in the outlay for producing a crop of corn than for any other plant commonly grown.

SELECTION IN SELF-FERTILIZED LINES.

The character, productiveness and general value of any combination of inbred strains can not be accurately determined from the inbred strains themselves. Many strains which are weak and undesirable in their inbred condition give astonishing results when

crossed. It is necessary therefore to test out many combinations to secure the ones that have outstanding value.

Not all crosses of inbred strains are superior to the original variety and like every other good product crossed corn requires extensive selection and much thorough testing in order to obtain something of real merit.

To have a reasonable chance of securing a good combination, many inbred strains must be obtained and then tested in many combinations. This work for the present can best be done by the State Experiment Stations and the Federal Department of Agriculture until the method is more generally used. The prospect of obtaining a particularly fine combination and being able to control the stock strains from which this cross is obtained holds out an inducement to originate valuable inbred strains. Never before in agricultural history has a seedsman been able to control a valuable plant improvement.

He who invents a new machine or a new process of manufacturing can patent his product and reap a reward for his industry and inventiveness. The originator of a new and improved plant or animal ordinarily loses control of his product as soon as he sells his first seeds or breeding stock.

With crossed corn the situation is entirely changed. The seed that is sold is used to produce a superior crop of corn but this in turn can not be used for further planting and the only way the same result can be secured is to obtain seed from the original producer each year. This is an advantage that will result beneficially to both the seedsman and the one who plants the seeds. This will stimulate the production of better kinds of corn as nothing else has ever done. Larger crops of better corn will be harvested on the same acreage and with the same labor. Therefore the cost of producing a bushel of corn will be reduced.

At this Station the method of obtaining good inbred strains is as follows. A variety is chosen which has been thoroughly tested and is known to be well adapted to the purposes to which it is to be put. A large number of the best ears of this variety are selected and seed from each ear is planted in a separate row in the field. About 20 to 30 plants are grown in each row. When the plants are ready to silk out five of the best plants are self-pollinated by hand.

This is a simple process with corn. A "three pound" paper sack is placed over the ear shoot as soon as it appears and before any silks are showing. The bag is slipped over the ear shoot without being opened and is held in place with a wire paper clip. At the same time, or a day or two later, an "eight pound" bag is put over the tassel and securely fastened around the stalk at the base of the tassel, also with a wire clip.

Two or three days later, depending upon the weather, when

the silks are out about three inches beyond the tip of the ear, the tassel is bent over and shaken into the tassel bag which has been unfastened. This collects the fine yellow powder, the pollen, which is dusted over the silks. The small bag is replaced quickly over the ear and the larger tassel bag is put over this, thus guarding against breaks in the bags which will let in pollen from outside. The bags are left on until the ears are gathered in order to mark them.

Pollination can only be done when the bags are dry. Wet

FIG. 17.—Self-fertilizing corn by hand pollination.

weather or heavy dew which causes the pollen to clump together renders it unfit for use. Only a very small quantity of good pollen is needed and this should be applied as soon as possible after the silks appear.

Care is taken to avoid touching the silks with the hands and also nearby plants are pushed away so that their pollen will not fall on the silks. Hand pollination in this way insures that the ears are fertilized with pollen from the same plant. This is the closest kind of inbreeding and will have very noticeable effects on the resulting progeny.

An inbred strain starting from an ear, borne on one plant, is called a self-fertilized line. From the five hand pollinated ears made the first year in each line, three of the most desirable are

selected for planting the next year. These three progenies are grown in rows and two plants are self-pollinated by hand in each row.

FIG. 18.—Two self-fertilized lines from the same variety which differ remarkably in height.

FIG. 19.—Ability to stand erect has a basis in inheritance as these two strains were derived from the same variety and grown for fifteen years under the same conditions.

At harvest the best and second best of the three progenies are noted in each line. Two ears from the best and one from the next best are planted the following year and this system is fol-

lowed for three or four generations. At that time many of the lines are fairly well fixed in their type and are uniform.

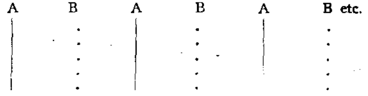
There are great differences between the several lines. Some are tall, others short and all degrees in between. Some have many tillers, others have few or none. Differences in ability to stand erect, in amount of smut damage, mold on the ears, and other characters of greater or less importance are noted.

Some lines are so unproductive that it is difficult to secure any seed from them. A number of promising strains are found that make a fairly good ear on every plant, all of the plants stand up during the season and have qualities that make them appear of value although few of them are more than half as productive as the variety started with. Nearly all of them are later in maturing than the variety at the start on account of their weakened condition. When crossed the plants grow and mature much faster and the value of the inbreeding process is at once apparent in the crossed progenies.

To obtain the best results it is necessary to test all of the best appearing inbred strains in combinations with each other. This is most easily done by hand-pollination, putting the pollen of one strain on the silks of the other and keeping a record of the strains combined.

METHODS OF PRODUCING CROSSED SEED.

When a good combination of two inbred strains, called a single cross, is once found it is a comparatively simple matter to produce crossed seed in quantity by planting the two inbred strains in alternate rows:



A = the pollen parent rows; the tassels are left on and seed from these plants is inbred and can be used for planting in a crossing plot another year.
B = the seed parent rows with all the tassels pulled out; seed from these plants gives crossed corn.

All of the plants of one kind are detasseled before any pollen is shed. This is done by pulling out or breaking off the tassel as soon as it appears above the leaves at the top of the stalks. Pollen is scattered by the wind as soon as the anthers, the tiny sacks suspended on short threads from the tassel branches, appear. These are put out first at the tip of the tassel and fresh ones come out every morning for several days. It is necessary to remove all

the tassels from all plants of one kind before the anthers can be seen. If pulled too soon the tassel sometimes breaks, leaving a portion in the plant which will later grow out and give off pollen.

If all of the tassels of one kind of plants are removed at the proper time all of the seeds produced on these plants must be cross-pollinated with the other strain. This is the seed to be used for field planting and will give vigorous and uniformly productive plants. Seed from the pollinator rows is all inter-pollinated and can be used for stock seed for planting in the crossing plot

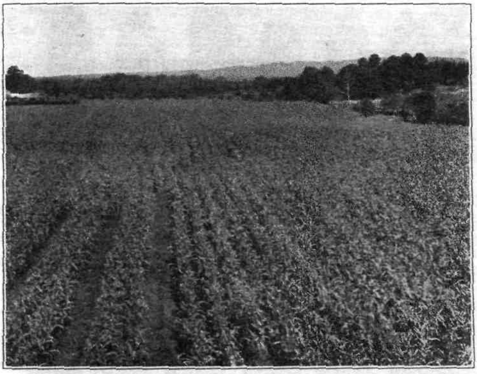


FIG. 20.—A field in which crossed seed corn is produced. Two rows are detasseled while every third row, planted with a different lot of seed, furnishes the pollen.

next year. By maintaining two crossing plots in separate fields, detasseling one type in one field and the other type in the second field, it is possible to have inbred stock seed of both types produced each year.

Crossing can be made either way as far as the product from the crossed plants is concerned. Reciprocal crosses in corn give results that are closely, if not exactly alike. Usually, however, it is desirable for one reason or another to make the cross one way. Some strains make better seed than others while a strain that may be poorer as a seed parent may be better as a pollen parent. If this is the case a small plot of the seed parent can be

grown in a field by itself to produce stock seed for planting in the crossing plot.

It is very important to maintain the stock seed of the two inbred types free from any outcrossing with any other corn. Pollen is blown by the wind for long distances. Fields that are 500 or more feet apart and not in the line of the prevailing winds will not show much mixing especially if they are separated by a barrier of trees or other windbreaks.

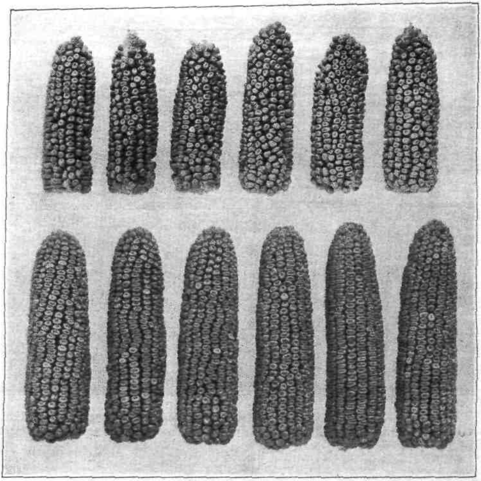


FIG. 21.—Two inbred strains showing uniformity of ear type.

Fortunately, when inbred plants are crossed with any unrelated kind of corn there is such a noticeable increase in the size of the crossed plants and change in type that is usually possible to detect such outcrosses and remove them before they produce pollen. In order to do this it is necessary to go through the crossing fields and rogue both the seed parent and pollen parent very carefully just before the tassels appear. It is best to remove or destroy the whole plant so that seed from them will not get mixed in with the stock strains.

Generally it will be found desirable to have the seed parent early in order to have the crossed seed for field planting well matured. The pollen parent can be later since pollen usually comes out well in advance of the silks. A small difference in this order will bring the two together at just the right time.

If there is much difference in time of silking and tasseling between the two parental stocks it is necessary to plant the two at different times. It is often difficult to know the right time to plant as the time of flowering varies with the season and changes unequally with different strains.

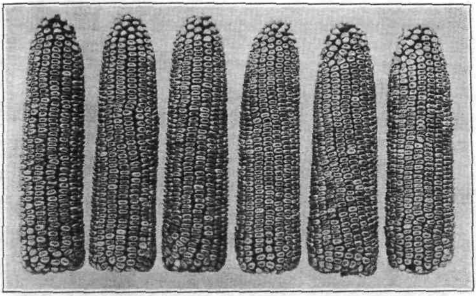


FIG. 22.—Crossing the two inbreds gives size and retains uniformity.

Two weeks difference in planting time will not make more than four or five days difference at pollinating time as the late planted corn tends to catch up with the early. However, if a dry spell or other unfavorable growing conditions intervene the later planting may not come on as fast as normally whereas the earlier planted corn may not be as much affected. For this reason it is advisable to plant the pollen parent at two different times, from ten days to two weeks apart. When the seed parent and pollen parent flower at about the same time a good plan is to plant all of the seed parent and half of the pollen parent at one time, leaving every other row of the pollinator to be planted ten days or two weeks later.

With vigorous corn it is not necessary to have the pollen-producing plants in every other row. One pollinating row to two, three or even four detasseled rows is sufficient depending on the amount

of pollen produced and the duration of the flowering period. This must be determined by trial for each particular combination and the field in which it is grown.

SINGLE CROSSES.

Hybrids produced by combining two fixed inbred strains are called single crosses and have the greatest uniformity and trueness to type in the first generation of any type of crossed corn.

FIG. 23.—*Crossed corn showing evenness in height and tassel formation.*

Where uniformity in size, shape and other ear characters and evenness in ripening are particularly important, as in sweet corn for market gardening and canning, it will probably be well worthwhile to use this method in spite of certain serious handicaps.

The principal difficulty of producing single crosses is the low yields and poor quality of the seed obtained from the weakened inbred plants. No inbred strains have been produced that will yield much more than half as much as the original variety when dependent upon their own pollen or pollen from other inbred strains. They also make a much smaller amount of pollen, and unless the two strains are planted at just the right time so that

pollen will be given out as soon as the silks appear, and continue until all the silks are out, the amount of crossed seed produced will be very low.

FIG. 24.—All of the ears ripen at the same time.

Inbred strains are also slower in ripening, and the thorough curing, so necessary to insure strong germination, is difficult to obtain.

The success of single crossing will depend very largely on the production of inbred strains which are sufficiently vigorous and productive to make a fair yield of seed. Since corn is being inbred very extensively there is every prospect that such inbred strains will soon be forthcoming and that this method can be used satisfactorily with sweet corn for market gardeners and canners.

DOUBLE CROSSES.

A further development of the method of crossing has been made which overcomes the handicap of low production and poor quality of seed of the first method. This is to cross two first generation hybrids. In this way four different inbred strains are combined by three crossings as follows:

Inbred Strains	A		B	C		D
Single Crosses	A	x	B	C	x	D
Double Cross	(A x B) x (C x D)					

The two crosses of inbred strains are made as described above. The two different lots of crossed seeds are planted in alternating rows in the same way and all the plants of one lot are detasseled in the same way as before. The seed produced on the detasseled plants is used for field planting. The seed from the plants that produced the pollen is of no further value either for field planting or for stock seed and must be discarded.

The two single crosses being vigorous and productive, a good yield of high quality seed is obtained. The crosses produced in this way by one hybrid type pollinated by another are no less productive than either parent and production may even be appreciably increased.

It is important to test the combinations first but when a high yielding and desirable double cross is once produced it can always be reproduced by combining the same strains in the same way.

It is essential that the four inbred strains be of such constitution that they will give good results in all combinations when crossed singly, particularly the crosses AC, AD, BC and BD. The combinations AB and CD should also grow well to give a good yield of seed. The four strains may all come from the same variety or from different varieties. In the latter case the two strains which form the seed parent should come from one variety and the two to form the pollen parent from the other.

Double crosses are not as uniform as single crosses either in height of plant, size and shape of ear, or in time of maturity.

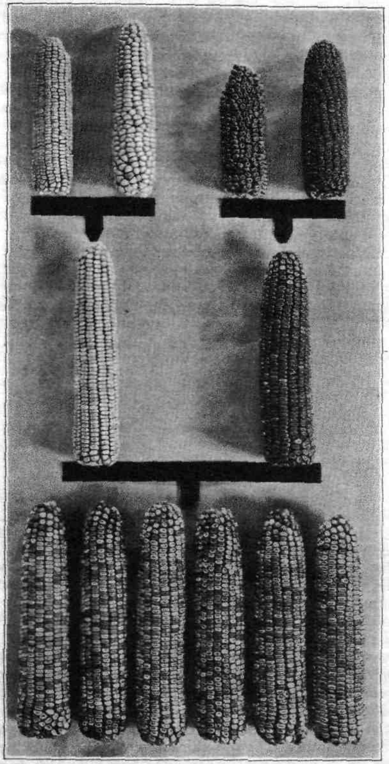


FIG. 25.—Illustrating by actual field results the bringing together of four inbred strains by three crossings to produce double crossed corn.

This is due to the fact that the first generation hybrids used for the seed and pollen parents are all producing ovules and pollen grains of unlike germinal constitution. However, all of the double crossed plants result from hybrid combinations. There is no opportunity for weaknesses to appear due to inbreeding. Hybrid vigor is therefore kept at the maximum and may even be increased. For that reason every plant is strong and sturdy and each one produces a good ear if given an equal chance to grow.

In field corn where uniformity is not so important the greater variability of double crosses may be an advantage in giving the plants a greater adaptiveness to different seasons and soils. All of the plants will not be at the same critical stage of development at some unfavorable period and may escape injury that would seriously damage a more uniform lot of plants.

The productiveness of a double cross compared to the single crosses and the original varieties is shown in the following combination of inbred strains self-fertilized four years, two strains from Century Dent and two from Leaming. Both varieties have been grown for many years in Connecticut, are well adapted to local conditions and are among the highest yielding of all the varieties tested at Mt. Carmel and at Storrs.

Variety or Cross	Yield in Bu. per Acre
Century Dent, 110	47.5
Leaming, 112	44.4
Inbred Century Strain, 110-2	15.3
Inbred Century Strain, 110-4	16.8
Inbred Leaming Strain, 112-1	42.7
Inbred Leaming Strain, 112-4	11.1
Single Cross, 110-2 x 110-4	51.2
Single Cross, 112-1 x 112-4	45.6
Double Cross (110-2 x 110-4) x (112-1 x 112-4)	69.8

The figures represent averages of from two to six plots of each lot. The yields have been corrected for soil differences according to results from the adjoining check plots and all are based on a uniform moisture content of 12 per cent. The double cross gave over 50 per cent more grain than the average of the two parental varieties.

The yield of one of the inbred strains is unusually high, nearly equalling the variety from which it was derived. The quality of the inbred corn was poorer than the variety and this yield was obtained in a field where there was an abundance of pollen. When planted in a separate field and dependent on its own pollen or pollen from another inbred strain it would probably not yield so high.

A combination of two inbred strains of Burr's White Dent and two of Leaming, both varieties originally from Illinois, has been found to give a large and vigorous stalk growth and generally

a higher yield of grain than any variety of corn grown in southern Connecticut. This particular combination is called Double Crossed Burr-Leaming and seed has been grown commercially since 1921. From 1918 to 1922 it was tested at Mt. Carmel in comparison with all of the varieties commonly grown in Connecticut and the yields are given in the first part of this bulletin.

This combination yielded more than all varieties in three out of the five years tested, while no one variety yielded more than

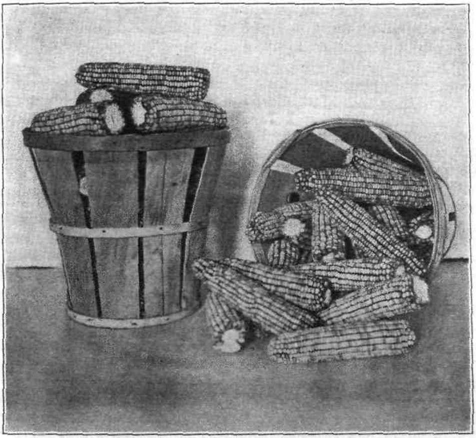


FIG. 26.—Double Crossed Burr-Leaming.

the others in more than one year. The greater return from Burr-Leaming is not only in the larger yield, but also in the freedom from mold, fewer nubbins and less soft corn. In addition the plants have a noticeable ability to stand erect when other varieties are blown down. and show a marked tendency to hold their foliage green until the seeds are ripe.

Although this new kind of corn will not out-yield all varieties, everywhere, in each season, it has been tested sufficiently under farm conditions to show that it can be planted profitably in many places.

Double crosses, like single crosses, will not maintain their high yields more than one year after the cross. From a field of Double Crossed Burr-Leaming that yielded well over one hundred bushels of shelled grain per acre, about one bushel of the largest and finest ears were selected. These were shelled together and this second generation seed was planted the following year in comparison with first generation seed. Two plots averaged 73.5 bushels in comparison with 95.1 bushels for the freshly crossed seed. This is a loss in grain of 23 per cent. The stalks grew vigorously and from the appearance in the field it seemed to be as productive as the first cross but at harvest time it was seen that many plants failed to make a good ear.

MULTIPLE CROSSES.

The principal objection to the method of double crossing is the necessity of maintaining four inbred strains of corn free from outcrossing with each other or other types of corn and making three separate crosses.

Theoretically, the same combinations of factors and in the same proportions can be secured by crossing the second generations from the two single crosses as by crossing the two first generation hybrids. A two years test shows that in the case of the Burr-Leaming combination the second generation of the Burr White single cross by the second generation of the Leaming single cross gives the same yield and quality of corn as the combination of the first generations of those two crosses. The yield and quality of the seed itself produced by second generation plants is not so good but the crop grown from that seed is in every way equal to the combination of the two first generation hybrids.

These results led to "multiple crosses," a further step in the evolution of crossed corn. A number of the best inbred strains of a variety are permanently combined into a fairly uniform type that can be propagated from year to year by natural inter-crossing, as are ordinary varieties. In other words, a "re-created" variety is produced in which all the best of the old variety has been combined and all the inherited abnormalities and weaknesses have been eliminated.

This recreated variety is now crossed with a similar combination of the best inbred strains from some other sort or perhaps a group of inbred strains of different type from the same variety.

Such a multiple cross would have the advantage of producing good yields of well developed seed and crossing each year would give maximum vigor and productiveness. This method has not yet been thoroughly tested but preliminary tests indicate that it will be feasible. The uniformity of the crossed plants produced

by this method may not be as great as in a double cross, but if the right combination of strains is made, yield should be maintained at a high level indefinitely.

MODIFIED SINGLE CROSSES.

Greater uniformity, where this is desirable, can be obtained by combining a number of strains from one line descending from a

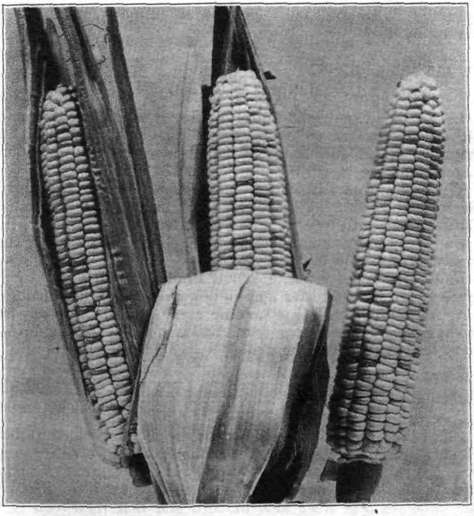


FIG. 27.—The uniform size and shape of ear and even ripening are important factors in sweet corn for market gardening and canning.

single plant but separated in the first or second generation and self-fertilized four or five years to rid them of recessive weaknesses and undesirable characters. Combining several of these sub-strains gives vigor and productiveness closely approaching the original variety and such a combination could be propagated from

year to year by natural inter-pollination, at the same time maintaining a fair degree of fixity of type.

When crossed with a similar combination of sub-strains descending from a different plant of the same or a different variety yield and vigor would be as great as in any system of crossing and the uniformity of the hybrid in certain combinations would be nearly as pronounced as in straight single crosses of two fixed inbred strains.

Crossed seed for field planting would be made each year. The yield and quality of the seed would be better than that produced by single inbred strains and nearly equal in these respects to the method of double or multiple crossing.

UNIFORMITY AND YIELD.

In all of these methods of crossing one must compromise between the uniformity of the crossed corn on the one hand and the vigor and productiveness of the stock strains used in making the cross on the other.

Where uniformity is of great importance it will be best to use the method of crossing two fixed and uniform inbred strains. Where trueness to type is not so important, as in field corn for grain or silage, maximum yields can be obtained, at a lower cost, by double crosses or multiple crosses.

In all systems of crossing inbred strains the variability of the crossed corn is no greater than is now present in all varieties of corn and is frequently less because every plant is vigorous and productive and much poor corn that is usually harvested from every field is largely eliminated.

NECESSITY OF USING CROSSED SEED.

All of these methods of crossing may seem complicated to those who are not familiar with the development of corn breeding practices. It is only necessary to remember, however, that two separate strains of corn must be maintained free from mixing with each other or any other kind of corn and that these two types must be planted in alternating rows and all the plants of one of them detasseled before pollen is shed. The seed produced on these castrated plants is used for planting to produce crossed corn.

The experience of twenty years indicates clearly that the largest yields together with the greatest uniformity and fixity of type adapted to particular requirements can only be obtained by some system of crossing. Furthermore the evidence is conclusive that

these crosses will not maintain their high yields and other desirable qualities in later generations, so that to secure the benefits of hybrid vigor it is necessary to plant crossed seed every year.

COST OF SEED CORN.

It requires about ten bushels of potatoes to plant an acre, about two bushels of oats and a bushel and a half of wheat for a similar area.

Depending upon the size of the kernels and the rate of planting a bushel of corn will plant from four to seven acres. For dent corn five quarts of seed is usually ample for each acre.

While the value of seed corn is somewhat more in proportion to the market value of the grain for corn than other commonly cultivated crops, the cost per acre of the seed is the lowest of the list, and compared to the other expenses of growing a crop of corn, the preparation of the soil, application of fertilizers, frequent cultivation, husking out or cutting up for silage, the cost of the seed becomes almost a negligible item.

For this reason the outlay for seed may be considerably increased, even doubled or tripled, and still be repaid many times over if the high priced seed gives an appreciable increase in yield or improvement in quality.

Crossed corn can do this. It has been tested long enough to show that, when the right combination is obtained, one which is adapted to the locality in which it is to be grown, it will easily pay for the increased cost of the seed, and leave a margin of profit as well.

BULLETIN 274 JANUARY, 1926

Connecticut Agricultural Experiment Station

New Haven, Connecticut

REPORT OF THE DIRECTOR

FOR THE

YEAR ENDING OCTOBER 31, 1925

The Bulletins of this Station are mailed free to citizens of Connecticut who apply for them, and to other applicants as far as the editions permit.

CONNECTICUT AGRICULTURAL EXPERIMENT STATION

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as of

October, 1925

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Tobacco Substation at Windsor.	Paul J. Anderson, Ph.D., *Pathologist in Charge.* N. T. Nelson, Ph.D., *Assistant Physiologist.*

REPORT OF THE DIRECTOR

FOR THE YEAR ENDING OCTOBER 31, 1925

To the Board of Control of the Connecticut Agricultural Experiment Station:

In accordance with the custom established some years ago, I have the honor to submit a review of the Station activities for the past year, and in addition a complete list of publications, the changes in staff and similar matters of general interest.

REVIEW OF THE YEAR

THE FIFTIETH ANNIVERSARY

The American agricultural station is now recognized by all as an essential agency of the state, but its establishment in Connecticut fifty years ago came only as the result of years of patient effort on the part of a few men. For twenty years, Professor Samuel W. Johnson urged the need of research in agriculture and in 1875 the General Assembly made the first appropriation. It was very fitting that the state and nation take note of the semi-centennial of this event.

On representation to the General Assembly, a small special appropriation was granted which made possible the arrangement of a suitable program. The celebration took place on the station grounds on Monday, October twelfth, and was attended by many prominent citizens of the state, directors of other experiment stations and representatives of the United States Department of Agriculture, the Association of Land Grant Colleges, Yale University, Connecticut Agricultural College and Wesleyan University. His Excellency, John H. Trumbull, Governor of Connecticut, presided and gave a brief address. Other addresses were given by Dr. E. W. Allen, Chief of the Office of Experiment Stations, United States Department of Agriculture, and Dr. R. W. Thatcher, Director of the New York Experiment Stations. As a part of the program a fine portrait of Dr. E. H. Jenkins was presented to the Station by Dean Henry S. Graves, Provost of Yale University, as a gift from Dr. Jenkins' many friends and admirers.

The wide recognition of the event and the esteem in which the station is held were also evidenced by the handsome parchment testimonials received from the Rothamsted Experimental Station, England, the Sheffield Scientific School of Yale University, and the Connecticut Agricultural College. In view of the general interest, there is now in preparation a bulletin which will include

a complete account of the proceedings, together with a history of the station and its work.

"DEFENSE" (CONTROL) WORK

INSPECTION OF FERTILIZERS, FEEDS, FOODS, DRUGS, ETC.

In accordance with statutes assigning such duties to the Station, the Department of Chemistry has analyzed 830 samples of fertilizers, 352 of feeding stuffs, 1800 of foods and drugs, besides making many miscellaneous determinations. By making a special

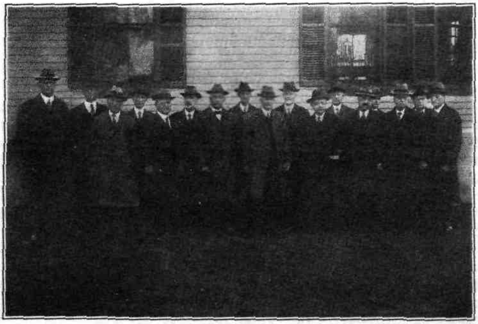

FIG. 28.—A Group of Guests at the Semicentennial.

effort, the Report on Fertilizer Inspection was completed and published early in the winter, thus placing information in the hands of farmers before the buying season.

In addition to the above the Chemistry Department calibrated 6000 pieces of Babcock glassware, examined Insecticides and Fungicides offered for sale in the State, made special studies of Diabetic Foods and of prescriptions dispensed by physicians, all of which are statutory duties.

THE NEW FEEDING STUFFS LAW

The last General Assembly amended the statute regarding "Commercial Feeding Stuffs," making the application broader and requiring registration of all brands. This went into effect July 1, 1925, and will increase the volume of the Station's work.

INSPECTION OF ORCHARDS AND NURSERIES

The new law passed by the General Assembly of 1925 requires that all nurseries register with the State Entomologist (who is also the Station Entomologist). This adds to the details of inspection but makes the law much more effective. About 150 nurseries are listed. A total of 2,977,346 imported plants were inspected and reported to the Federal Horticultural Board. Many orchards and gardens have also been examined on request.

A new service to fruit growers, as a basis for their spraying plans, was a special survey of orchard pests maintained during the

FIG. 29.—Fighting the Gipsy Moth. The can contains parasites that attack Gipsy Moth Eggs.

spring and early summer. This information was disseminated at timely periods through coöperation with the Extension Service of the Agricultural College and was made possible by the addition to the staff of another botanist, who has also assisted in the inspection of nurseries and orchards, thus covering the plant diseases more thoroughly than has been possible heretofore.

THE GIPSY MOTH

There has been no serious spread of this pest and all in touch with the situation are encouraged. Our entomologists, in coöperation with the Federal workers, have scouted 108 towns, creosoted

20,921 egg clusters, sprayed 276 colonies and scouted 8,399 miles of roadway. Parasites of several species have been released and the prospect for this method of control is good.

THE EUROPEAN CORN BORER

Through coöperation with the U. S. Department of Agriculture, part of the shore has been scouted. Five infestations were discovered and the burning of plants that harbor the larvae will be undertaken this winter. So far there is no cause for alarm but all citizens along the shore are urged to report suspected outbreaks.

FIG. 30.—A "Mosquito" Problem. This ditch leads from a marsh and has been used as a public dump.

THE MOSQUITO NUISANCE

The summer of 1925 proved one of the worst in years. Owing to the lack of state funds, the ditches in some cases are in charge of the towns and cities. A series of dry years relaxes the local interest, new real estate developments affect the drainage, ditches are used for public dumps and when a wet season comes, the mosquitoes become a very real pest. In so far as the State appropriation allows, the areas in charge of the Station have been kept in good condition, but adjacent areas uncared for or undrained will furnish an ample supply of mosquitoes, for they will fly several miles. In West Haven the town authorities became very active about the middle of the season and 1926 should see much improvement. Fairfield, Greenwich and Stamford are also active.

State funds are insufficient for new work. The only new area drained was part of Westbrook where $1,100 was voted by

the town and considerable ditching done. Clinton has voted $10,000 to be spent in 1926 and East Haven is about to undertake an elaborate program.

Under the new statute, contributions by the towns are voluntary, so that in spite of a small increase in the state appropriation, the funds available for maintenance are actually reduced. Unless towns, cities, boroughs and individuals take an active interest and raise funds, we may expect to find our shore communities and resorts very uncomfortable.

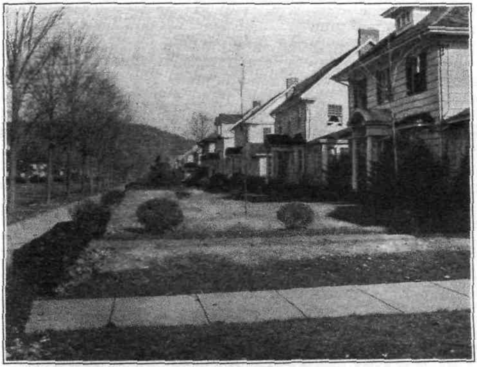

FIG. 31.—Lawn in Westville (New Haven) injured by the Asiatic Beetle.

THE ASIATIC BEETLE

This new pest of lawns has spread over a considerable area in Westville (New Haven). Local eradication is no longer effective. As a result of a careful survey, the entomologist has undertaken a campaign for complete eradication. This will require coöperation of the State, the U. S. Department of Agriculture, the City and some 700 householders. If funds ($25,000) are raised, work will begin this spring and it is hoped to stamp out the infestation by fall.

CONTROL OF WHITE PINE BLISTER RUST

The statute charges the Station with the work of control and eradication of this disease, the U. S. Department of Agriculture coöperating. During the past year a large crew operated in

Canaan, Salisbury and North Canaan, removing gooseberries and currants which spread the disease. For the entire state 15,691 acres were cleaned and scouting done in 15 towns.

PROGRESS OF INVESTIGATIONS

THE VEGETABLE PROTEINS

Recent observations of *unusually rapid growth* in several groups of rats on special diets have led to consideration of the so-called "curve of normal growth." Whereas we have considered 65 to 70 days the normal period for growth from 60 to 200 grams, animals on certain rations have recently made the same gains in 38 days. This may be due to any one of several causes. So far we have been unable to account for it to our own satisfaction.

Results of work in collaboration with Dr. Mason of Yale University indicate the existence of a *"fertility factor,"* in the absence of which degenerative changes procede in the testes, and fertility becomes impaired despite excellent somatic growth. Dr. Mason states in his report to the National Academy of Science (Apr. 1925)—"Addition of lettuce to the basic ration prevented the testicular degeneration which would otherwise occur. The effect of the lettuce is due to its richness in the anti-sterility vitamine E. The presence of this vitamine seems absolutely necessary for normal reproductive function and germ cell maturation."

By applying his ether method to the leaves of spinach, Dr. Chibnall has prepared a new protein *"spinacin"* from the cytopplasm. A protein of similar properties was also obtained from the leaves of maize.

Our experience with the problems presented by the *analysis of juice of the alfalfa plant* has shown the necessity for much further study before any adequate picture may be formed of the chemical reactions of the metabolism of the plant. Much attention is now being given to this problem.

BREEDING BETTER CORN AND VEGETABLES

"Crossed Corn" continues to give superior results wherever tested. On field corn special effort is now being directed to perfecting a simple method of producing crossed seed of such strains on a large scale, thus removing the objection raised by farmers.

Two new varieties of *sweet corn* have been produced by this new method of corn breeding which consists of crossing two uniform and fixed inbreds and utilizing only the first generation hybrid. *"Crossed Crosby"* is an early white corn of the Crosby type, having 12 to 16 rows and ripening about one week earlier than Golden Bantam. *"Red-Leaved White Evergreen,"* mentioned in the

report last year, is a pure white corn of the very best quality, medium in size, prolific and ripens in mid season. The leaves and husks are light reddish which makes the corn easily recognized on the market. Seed of these hybrids is now available in small quantities for testing and may be obtained by writing the Station.

The same method used heretofore is now being applied to *"Whipple's Early Yellow"* sweet corn, the aim being to improve the quality and give it the uniformity in size, shape and ripening that is characteristic of all "Crossed Corn."

Improvement of *vegetables* is now under way on an intensive plan. Cross fertilized crops like asparagus, beets, carrots, cab-

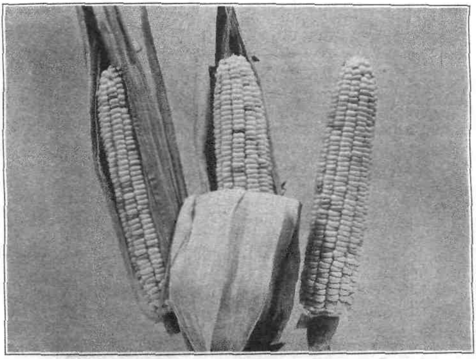

FIG. 32.—"Red leaved" Evergreen Sweet Corn.

bage, onions, rutabagas and squash, are being subjected to breeding and selection, following the same general method so successful with corn. For the self-fertilized vegetables selection methods are being applied, those receiving principal attention being beans, lettuce and tomatoes.

At the Station farm at Mt. Carmel where this work is carried on the plant breeder is also testing such new strains of vegetables as the Yellows-resistant Savoy Spinach originated by the Norfolk (Va.) Truck Station, a pod spot-resistant bean from the Cornell Station, the Vermont Hubbard Squash, Penn State Earliana Tomato and Penn State Ball Head Cabbage from the Pennsylvania Station, along with the varieties now standard in this region.

PLANT DISEASES

Celery blight causes heavy losses to market gardeners but few are equipped to spray. Dust is more easily applied but the results for this season are no more encouraging than last. Dust gives some control but Bordeaux spray is much more effective.

FIG. 33.—Spraying Celery on Experimental Plots.

As a result of several years careful work it has been shown that "Black Root Rot" of tobacco is caused by *Thielaviopsis basicola*, a fungus distinct from *Thielavia basicola*, which was formerly supposed to be the asco stage.

The study of *mosaic* has now been in progress twenty-two years. Perhaps no other plant disease has attracted so wide attention in

recent years, many botanists having taken up this perplexing problem. At this Station we are encouraged by recent discoveries which will throw further light on the nature of the disease. A bulletin is now in preparation.

Apple and Peach Diseases continue to occupy much attention. The trials of new dusts and sprays, combinations of both and methods of application, were continued in the Station orchards at Mt. Carmel farm and at the farms of Mr. Platt at Milford.

FIG. 34.—Young Pine Plantation in Brush Land.

THE INFLUENCE OF SOIL ON THE FOREST

This is practically a virgin field upon which the station foresters began work two years ago. Very little work has been done in this country or abroad, partly due to the lack of knowledge of the soils in forested regions. In Connecticut fully two-thirds of the land area is best suited to forestry, at least under present economic conditions. If the soil is a factor to be reckoned with in planting and managing forests and wood lots, then it is essential that we know the part it plays. To discover the facts a detailed study is now under way in close coöperation with the Soils Department. On each of our important soil types several timbered plots have been laid out. Careful measurements are made of the species, growth and stand as well as of the factors of soil water, reaction, and nutrients present. Out of this we hope to establish the effect, if any, of soil on our native and introduced trees and the adaptation of these latter to our conditions.

AN INVENTORY OF OUR FOREST PLANTATIONS

There is a dearth of collected information for our many citizens ʋho wish to make forest plantings. For many years our advice n plantings has been based largely on European experience. There are now many plantations in the state over twenty years of .ge. To bring together this mass of individual experience a care-ul survey is now being made.

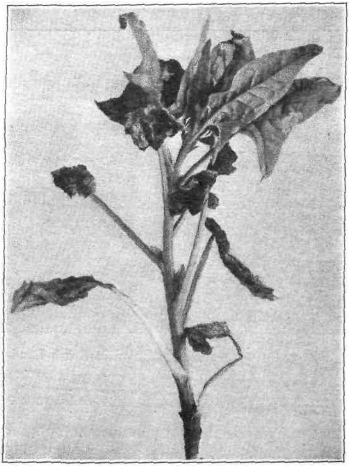

FIG. 35.—Injury to spinach caused by the Spinch leaf miner.

INSECT PROBLEMS

The *Plum Curculio* on Apple is receiving careful study. As a control there was introduced into the spray, lead arsenate coated with lead sterate and fish oil sticker. Marked decrease has been noted in the number of curculios this year, but this may be due to previous treatments or other conditions.

Foul Brood of Bees, on which work was begun in 1924, seems to yield to treatment with Hutzelman's alcohol-formalin solution. Other solutions of formalin were tried with encouraging results.

The Chemical Changes in Spray Mixtures present an important and interesting problem. It has been found that the amount of sulfur in solution directly affects the solubility of arsenic in lime-sulfur, lead arsenate, nicotine and casein mixtures.

The Oriental Peach Moth has apparently spread over all the state and more damage resulted in 1925 than 1924, being found also in quinces. Some orchards reported over 50 percent of the peaches wormy. So far no real control has been found although some reduction of injury was obtained by spraying in June with nicotine to kill the eggs and dusting later with lead arsenate-sulfur dust. Many other treatments are being tried. Bait pans containing molasses and yeast caught large numbers of moths and this may offer some relief.

An investigation was begun on the control of the *Spinach Leaf Miner* and this will be actively followed next year.

SPRAYING VS. DUSTING

Spraying vs. dusting experiments were continued in 1925 as before except to discontinue the use of copper dust and to add some promising combinations of spray and dust. The season of 1925 was unfavorable for the development of fungous diseases and as insects are usually well controlled by dusting, *all* the treatments gave quite good results. Spraying ranked first, a combination of spray for the first three treatments and dust for the last three was second, sulphur dust third, with other schedules ranking still further down the scale.

CONNECTICUT SOILS AND THEIR RESPONSE TO FERTILIZERS

Soils from twenty-four areas representing the most important soil types of the state are being studied exhaustively in the greenhouse and laboratory, with a view to determining how and why they differ in productive capacity and economic value. Chemical studies of nearly one hundred samples of soil show the following:

POUNDS PER ACRE IN SURFACE SOIL.

	Nitrogen	Phosphorus	Potassium*	Limestone requirement, Tons per A.	pH
Average	4,178	1,760	30,220	2.78	5.43
Highest	9,850	4,080	45,100	0	7.0
Lowest	826	502	17,800	7.57	4.1

* 12 soils only.

An example of what these results may mean is shown with soil No. I, preliminary pot studies upon which were begun in 1925.

The analyses showed 3,550 lbs. nitrogen, 1,238 lbs. phosphorus and 43,000 lbs. potassium per acre in the surface soil, with a limestone requirement of three tons per acre, and a high active acidity, 4.9 pH. The total phosphorus content was considerably below the average, and chemical tests showed this phosphorus to be in a very unavailable state. The illustration indicates the response of alfalfa when phosphorus and lime were applied to this soil.

FIG. 36.—The effect of several treatments on Soil No. 1 as shown by the growth of Alfalfa. K = Potash, P = Phosphoric Acid, L = Lime.

THE TOBACCO STATION AT WINDSOR

On March first, 1925, Dr. Paul J. Anderson took charge of the Tobacco Substation, since which time the program has gone forward in a very satisfactory manner.

Several special problems arose during the year, notably a severe outbreak of *wire worms*. The staff at Windsor with the entomologists at New Haven spent considerable time in testing various treatments and secured fair results from the use of calcium cyanide drilled in. If there is another outbreak in 1926, this will be tested further.

It has been known for a long time that *Black Root rot* injury might be increased by making the soil too alkaline, but there was no accurate data on just how acid a soil must be kept to be safe.

Studies carried on in the past season indicate that a soil may test as high as 5.9 pH without danger.

The soil conditions on the *Brown Root Rot* series not being satisfactory, a new series of plots was laid out last spring on the farm of Mr. Conner at Poquonock. No conclusions can be drawn for several years but the season of 1925 was very encouraging. Mr. Murwin of the U. S. Department of Agriculture had immediate charge of this project.

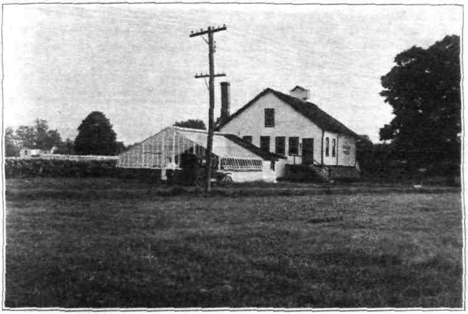

FIG. 37.—The Tobacco Station at Windsor—showing laboratory and greenhouse.

As usual, much time was spent in direct *service* to growers, who, in increasing numbers, bring their problems to the Tobacco Station or request visits. Dr. Anderson has also spoken at a number of meetings.

Four hundred growers attended the Tobacco Field Day, held at the farm on July 28. The visitors were conducted over the plots and the work explained. Following lunch a very interesting program was held.

MT. CARMEL FARM FIELD DAY

In view of the fact that an exhibit was to be sent to the Charter Oak Fair and the Semi-centennial celebrated in October, the Board voted to omit the usual field day at the Station Farm at Mt. Carmel. It is planned to arrange a special program next year in conjunction with the Farm Bureau.

CHANGES IN THE STATION STAFF

Appointments:

George D. Scarseth, B.S., Graduate Assistant in Soils, February, 1925.
Paul J. Anderson, Ph.D., In charge Tobacco Station at Windsor, March, 1925.
George E. Graham, Superintendent of Buildings and Grounds, June, 1925.
A. D. McDonnell, General Assistant in Botany, June, 1925.

Resignations:

A. E. Moss, M.F., Assistant Forester, June, 1925.
William Veitch, Superintendent of Buildings and Grounds, June, 1925.
G. E. Graham, Assistant in Botany, June, 1925.

PHYSICAL EQUIPMENT

As is customary, major repairs and additions to equipment are made toward the end of the fiscal biennium. This period ended June 30, 1925, and during the spring and summer the station buildings were painted, walks repaired and the entire plant put into good condition.

The General Assembly of 1925 provided $5,000 for the erection of a new section of the greenhouse on the station grounds. This takes the place of the house torn down in 1918 to make room for the proposed Board of Health laboratory. The new house is now under construction, is 22 by 85 feet and will make space for considerable expansion of the work in plant breeding and soils.

At the Tobacco Station at Windsor, a "Carrier Apparatus" for controlling temperature and humidity was installed in the curing chambers, thus making possible normal curing of small lots of tobacco, an impossibility in the sheds. This single piece of equipment cost $3,500 but much of our work was at a standstill without it. A small greenhouse was also erected at the Tobacco Station.

About 900 volumes were added to the library, which now includes 16,200 volumes and a very complete equipment of scientific journals. The station received from Dr. T. B. Osborne a very valuable gift of rare chemical journals totaling 3,500 volumes.

The inventory of June 20, 1925, shows:

Value of land and buildings	$304,550.00
Value of contents	120,884.80
	$425,434.80

WHAT THE STATION CAN DO

Each mail brings to the station requests for information and service, the range of subjects being almost without limit. Every ... to comply with these requests, even though they ar

outside the fields under investigation. This is one of the purposes for which the library is maintained. However, some of the letters request help that requires an intimate knowledge of live stock management and the like and again we are asked to make laboratory determinations for which we do not have the equipment or staff. Therefore it is helpful to publish from time to time a list of the subjects on which we can furnish information and the kinds of samples we can accept.

The Station can furnish information on:

Fertilizers and fertilization.
Soils and their management.
The chemical composition of Foods, Drugs, Insecticides and Fungicides.
The composition of Diabetic Foods.
Insect Pests of plants and their control.
Fungus and other Diseases of plants and their control.
Sprays and spraying.
Fruits and fruit management.
Weeds and their control.
Forestry—all phases.
Care of Shade Trees.
Plant breeding—especially field and sweet corn.
Lawns, establishment and care.
Bees.
Mosquito Elimination.
Tobacco culture.

Samples and specimens that can be analyzed, tested or identified:

Fertilizers.
Feeding stuffs.
Foods and Drugs.
Milk—except for bacterial content.
Seeds.
Weeds and other plants.
Insects.
Diseased and injured plants.
Soils.

The Station cannot furnish information on:

Live stock feeding and management, including Poultry.
Animal diseases.
Household management.
Clothing.
Farm management.
Marketing and coöperation.

Requests for information on these subjects should be sent to the Connecticut Agricultural College at Storrs.

The Station cannot make analyses and examinations of:

Drinking water—apply to the State Board of Health, Hartford.
Milk for bacterial content—apply to the Dairy Commissioner, Hartford.
Sick or dead poultry should be sent to Poultry Department. Storrs Experiment Station, Storrs, Conn.

PROJECTS ACTIVE DURING THE YEAR

Analytical Chemistry

Dr. E. M. Bailey in charge

1. Inspection of Fertilizers.
2. Inspection of Feeding Stuffs.
3. Inspection of Foods and Drugs.
4. Calibration of Babcock Glassware.
5. *Inspection of Insecticides and Fungicides.*
6. Studies on Methods.
7. Analysis of Diabetic Foods.
8. Analysis of Check Samples—Cottonseed Meal and Mixed Fertilizers.
9. A Study of the chemical changes in Standard Spray Mixtures. (See also Entomology No. 14.)

Biochemistry

Dr. T. B. Osborne in charge

(In collaboration with Dr. L. B. Mendel, Yale University.)

1. A Study of the Relation of Diet to the Development of Bone.
2. The Effect of High Protein on the Kidney and Other Organs.
3. Experiments on the Influence of Diet on Fertility.
4. The Relation of Diet to the Rate of Growth.
5. Further Study of the Part Played by Individual Amino-Acids in Nutrition.
6. The Investigation of the Chemical Constituents of Green Leaves.

Botany

Dr. G. P. Clinton in charge

1. The Effect of Fertilizers, Especially Nitrate of Soda, on the Growth, Yield, Longevity and "Yellows" of Peaches.
2. *The Nature and Cause of Mosaic Disease of Plants.*
4. The Rusts of Connecticut.
5. Plant Disease Survey of Conn.
6. Thielavia Basicola; a Study of the Perfect Stage.
7. A Study of Pythiums.
8. Comparison of Spraying and Dusting on Apples and Peaches, Especially to Try New Dusts. (See Entomology No. 3.)
9. Control of Celery Blights with Sprays and Dusts.
13. Peach "Yellows."
15. Chestnut Blight—virulence studies.
16. White Pine Blister Rust. (Certain phases of the life History.)
21. Influence of Bud Inheritance on Yield of Peaches.
22. Influence of Root Grafts on Scions of Apples.

Entomology

Dr. W. E. Britton in charge

1. The Life History, Habits and Control of the Plum Curculio on Apple.
3. *Comparisons of Spraying and Dusting on Apples and Peaches, Especially to Try New Dusts. (See also Botany No. 8.)*

6. Control of Foul Brood of Bees.
7. A Study of the Life History and Methods of Control of the Asiatic Beetle, *Anomala orientalis.*
9. Insect Survey of Connecticut.
14. A Study of the Chemical Changes in Standard Spray Mixtures. (See also Chemistry No. 9.)
15. Bionomics of the Birch Leaf Skeletonizer, *Bucculatrix canadensisella.*
16. Experiments with Baits Attractive to the Cabbage Maggot Fly.
17. Life History and Methods of Controlling the Oriental Peach Moth, *Laspeyresia molesta.*
18. Life History of Imported Current Worm.
20. Life History, Habits and Control of the Imported Birch Leaf-Miner, *Fenusa pumila Klug.*
21. Life History and Control of the Spinach Leaf-Miner.
22. Insects Infesting Nursery Stock in Connecticut.

Control Projects

10. Inspection of Orchards and Nurseries.
11. Control of Gipsy Moth.
12. Elimination of the Mosquito Nuisance in Salt Marshes.
13. Inspection of Apiaries.
19. Control of the European Corn Borer.

Forestry

Mr. W. O. Filley in charge

1. Experimental Plantations on a Sandy Tract at Rainbow.
   a. Comparison of a wide variety of conifers and hardwoods.
   b. Methods of management for those species that have survived.
   c. Studies on growth and habits of the several species.
2. Effect of Thinning in White Pine (At Shaker Station)—Three Grades of Thinning.
3. Effect of Thinning in Hardwoods (At Quassapaug Lake).
8. Studies of Forest Plantations (State-wide).
   a. Comparative growth of various species.
   b. Reasons for success or failure.
   c. Soil and other site factors necessary for success of each species.
10. Distribution and Growth of Forest Trees as Influenced by Soil Conditions.
   a. To determine the basic factors inherent in forest soils which influence the natural growth and distribution of trees.
   b. To study the natural distribution of tree species and forest types with reference to soil.
   c. To study the growth and yield of forests as influenced by soil factors.
11. Coniferous Seed Bed Study to Determine:
   a. The value of fertilizers in seed beds.
   b. The value of different amounts of seed.
   c. The value of dusts and sprays in preventing damping off.

Control Project

7. Control of White Pine Blister Rust.

Genetics

Dr. D. F. Jones in charge

1. A Genetic Study of Hereditary Characters in Corn Involving Their Linkage Relations and Variability.
2. The Effects of Inbreeding and Crossing upon Corn in Relation to Vigor, Rate of Growth, Productiveness and Variability.
3. Methods for the Improvement of Naturally Cross-Fertilized Plants by Selection in Self-Fertilized Lines with Particular Attention to the Monoecious, Wind-Pollinated Corn Plant.
4. Methods for the Improvement of Naturally Self-Fertilized Plants with Particular Attention to Tobacco.

Soils

Mr. M. F. Morgan in charge

1. What Soil Type Characteristics are Factors in Determining Land Utilization.
2. Experiments in Lawn Fertilization.

Tobacco Sub-Station at Windsor

Dr. P. J. Anderson in charge

1. Fertilizer Tests.
   a. Sources of Nitrogen.
   b. Rates and Sources of Phosphoric Acid.
   c. Sources of Potash.
   d. Fractional Applications Compared with Broadcast at Different Rates.
   e. Miscellaneous Materials.
2. Strain Trials of Havana Seed and Broadleaf (Plant Breeding).
3. Improvement of Cuban Shade-grown—(Plant Breeding).
4. Effect of Various Cover Crops on Yield, Quality and Disease.
5. Tobacco Sick Soils (Brown Root Rot) with U. S. D. A.
6. Black Root Rot—Relation of Soil Reaction.
7. Trials with Cigarette and other Types of Tobacco.

PUBLICATIONS

Bulletins

No. 261. Fertilizer Report for 1924.
No. 262. The Rainbow Forest Plantations.
No. 263. Second Report of the Tree Protection Examining Board.
No. 264. Report of the Director for the Year Ending Oct. 31, 1924.
No. 265. Report of the State Entomologist, for 1924.
No. 266. The Improvement of Naturally Cross-Pollinated Plants by Selection in Self-Fertilized Lines. 1. The Production of Inbred Strains of Corn.
No. 267. Report on Food and Drug Products (1924).
No. 268. Report on Commercial Feeding Stuffs (1924).
No. 269. Perithecia of Thielavia Basicola Zopf in Culture and the Stimulation of their Production by Extracts from other Fungi.

TOBACCO SERIES

No. 5. Fertilizer Experiments with Tobacco.

Circulars of Immediate Information

No. 48. Practical Lawn Suggestions.
No. 49. Regulations for Carrying Out the Provisions of the Law Concerning Concentrated Commercial Feeding Stuffs.
No. 50. Regulations Concerning the Shipment of Nursery Stock, and the New Law.

Journal Papers

Biochemistry

Ophthalmia as a Symptom of Dietary Deficiency.
Thomas B. Osborne and Lafayette B. Mendel. American Journal of Physiology, 1924, LXIX, 543-547.

A Note on Dakin's Method as Applied to Edestin.
Thomas B. Osborne, Charles S. Leavenworth and Laurence S. Nolan. Journal of Biological Chemistry, 1924, LXI, 309-313.

The Role of Vitamine B in Relation to the Size of Growing Rats.
Thomas B. Osborne and Lafayette B. Mendel. Journal of Biological Chemistry, 1925, LXIII, 233-238.

Variations in the Kidney Related to Dietary Factors.
Thomas B. Osborne, Lafayette B. Mendel, Edwards A. Park, and Milton C. Winternitz. American Journal of Physiology, 1925, LXXII, 222.

Recent Advances in Protein Chemistry.
Hubert Bradford Vickery. Industrial and Engineering Chemistry, 1924, XVI, 1029-1030.

Some Nitrogenous Constituents of the Juice of the Alfalfa Plant.
I. The Amide and Amino Acid Nitrogen.
Hubert Bradford Vickery. Journal of Biological Chemistry, 1924, LX, 647-655.

Some Nitrogenous Constituents of the Juice of the Alfalfa Plant.
II. The Basic Nitrogen.
Hubert Bradford Vickery. Journal of Biological Chemistry, 1924, LXI, 117-127.

Some Nitrogenous Constituents of the Juice of the Alfalfa Plant.
III. Adenine in Alfalfa.
Hubert Bradford Vickery and Charles S. Leavenworth. Journal of Biological Chemistry, 1925, LXIII, 579-583.

Note on the Basic Amino Acids Yielded by Casein.
Charles S. Leavenworth. Journal of Biological Chemistry, 1924, LXI, 315-316.

A Protein from the Leaves of the Alfalfa Plant.
Albert Charles Chibnall and Laurence S. Nolan. Journal of Biological Chemistry, 1924, LXII, 173-178.

A Protein from the Leaves of Zea mays.
Albert Charles Chibnall and Laurence S. Nolan. Journal of Biological Chemistry, 1924, LXII, 179-181.

Spinacin, a New Protein from Spinach Leaves.
Albert Charles Chibnall. Journal of Biological Chemistry, 1924, LXI, 303-308.

Milk as a Food.
Lafayette B. Mendel. Transactions World's Dairy Congress of 1923, Government Printing Office, Washington, 1924.

Le Lait, en tant qu'aliment.
Lafayette B. Mendel. Bulletin de la Societe scientifique d'Hygiene alimentaire, 1925, XIII, 147-157.
An Experimental Study of Ophthalmia in Rats on Rations Deficient in Vitamin A.
Arthur M. Yudkin. Archives of Ophthalmology, 1924, LIII, 416-425.

Botany

(a) Dusting versus Spraying of Celery, and (b) List of Fungous, Bacterial and Non-Parasitic Injuries of Connecticut Vegetables.
G. P. Clinton. Report Connecticut Vegetable Growers' Association, 1924: 54-8, 1925.
Recent Studies on Certain Apple Diseases and Their Control.
G. P. Clinton. Annual Report of Connecticut Pomological Soc. 1924: 65-73, 1925.

Entomology

Meeting of Connecticut Entomologists.
W. E. Britton. Journal of Economic Entomology, v. 17, p. 669-673. Dec. 1924.
Some Insect Information from a Connecticut Conference.
W. E. Britton. Florists' Exchange, v. LVIII, n. 22, Nov. 1924.
Better Care of Shade Trees.
W. E. Britton. Tree Talk, v. 6, n. 4, Feb. 1925, p. 4.
Fruit Pests—Important New Ones and Troublesome Old Ones.
W. E. Britton. 31st Annual Meeting of the Massachusetts Fruit Growers' Association, Inc., January, 1925, p. 118-131 (issued April, 1925).
Recent Developments in Insect Control.
W. E. Britton. Proceedings 34th Annual Meeting, Connecticut Pomological Society, Dec. 1924, p. 48 (issued 1925).
Report of Committee on Injurious Insects.
W. E. Britton. Proceedings 34th Annual Meeting, Connecticut Pomo logical Society, Dec., 1924, p. 46 (issued 1925).
Insects Attacking Vegetable Crops in Connecticut in 1924.
W. E. Britton. Report Connecticut Vegetable Growers' Association, 1 43 (issued 1925).
A New Genus and Species of Trombidiidae.
Philip Garman. Journal New York Entomological Society, v. XXXII p. 85, June, 1925.
Notes on Bee Diseases in Connecticut.
Philip Garman. Journal of Economic Entomology, v. 18, p. 445, Jun 1925.
The Oriental Peach Moth Problem.
Philip Garman. Proceedings 34th Annual Meeting, Connecticut Pom logical Society, Dec., 1924, p. 57 (issued 1925).
Experience with Baited Traps in Controlling Cabbage Maggots.
R. B. Friend. Report Connecticut Vegetable Growers' Association, 50, 1925.

Genetics

Origin of Flint and Dent Corn.
D. F. Jones. Jour. Heredity, 15: 417-419, 1924.
Genetics in Plant and Animal Improvement.
D. F. Jones. John Wiley & Sons, 1925.

Genetics and Morphology of some Endosperm Characters in Maize.
P. C. Mangelsdorf. Thesis in partial fulfillment of requirements for the degree of Doctor of Science, Bussey Institution, Harvard University, 1925.

All of which is respectfully submitted,

WILLIAM L. SLATE, JR.,
Director.

BULLETIN 275 FEBRUARY, 1926

Connecticut Agricultural Experiment Station

New Haven, Connecticut

TWENTY-FIFTH REPORT

OF THE

STATE ENTOMOLOGIST

OF

CONNECTICUT

1925

W. E. BRITTON, Ph.D.
State Entomologist

The Bulletins of this Station are mailed free to citizens of Connecticut who apply for them, and to other applicants as far as the editions permit.

CONNECTICUT AGRICULTURAL EXPERIMENT STATION

OFFICERS AND STAFF

as of

February, 1926

BOARD OF CONTROL

His Excellency, John H. Trumbull, *ex-officio, President*

Charles R. Treat, *Vice-President*	Orange
George A. Hopson, *Secretary*	Mount Carmel
Wm. L. Slate, Jr., *Director and Treasurer*	New Haven
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STAFF.

E. H. Jenkins, Ph.D., *Director Emeritus.*

Administration	Wm. L. Slate, Jr., B.Sc., *Director and Treasurer.* Miss L. M. Brautlecht, *Bookkeeper and Librarian.* Miss J. V. Berger, *Stenographer and Bookkeeper.* Miss Mary E. Bradley, *Secretary.* G. E. Graham, *In charge of Buildings and Grounds.*
Chemistry. Analytical Laboratory.	E. M. Bailey, Ph.D., *Chemist in Charge.* R. E. Andrew, M.A.; C. E. Shepard; Owen L. Nolan; Harry J. Fisher, A.B.; W. T. Mathis — *Assistant Chemists.* Frank C. Sheldon, *Laboratory Assistant.* V. L. Churchill, *Sampling Agent.* Miss Mabel Bacon, *Stenographer.*
Biochemical Laboratory.	T. B. Osborne, Ph.D., *Chemist in Charge.* H. B. Vickery, Ph.D., *Biochemist.* Miss Helen C. Cannon, B.S., *Dietitian.*
Botany.	G. P. Clinton, Sc.D., *Botanist in Charge.* E. M. Stoddard, B.S., *Pomologist.* Miss Florence A. McCormick, Ph.D., *Pathologist.* Willis R. Hunt, Ph.D., *Assistant in Botany.* A. D. McDonnell, *General Assistant.* Mrs. W. W. Kelsey, *Secretary.*
Entomology.	W. E. Britton, Ph.D., *Entomologist in Charge; State Entomologist.* B. H. Walden, B.Agr.; M. P. Zappe, B.S.; Philip Garman, Ph.D. — *Assistant Entomologists.* Roger B. Friend, B.S., *Graduate Assistant.* John T. Ashworth, *Deputy in Charge of Gipsy Moth Wo* R. C. Botsford, *Deputy in Charge of Mosquito Elimination.* Miss Gladys M. Finley, *Stenographer.*
Forestry.	Walter O. Filley, *Forester in Charge.* H. W. Hicock, M.F., *Assistant Forester.* J. E. Riley, Jr., M.F., *In charge of Blister Rust Control.* Miss Pauline A. Merchant, *Stenographer.*
Plant Breeding.	Donald F. Jones, S.D., *Geneticist in Charge.* P. C. Mangelsdorf, S.D., *Assistant Geneticist.*
Soil Research.	M. F. Morgan, M.S., *Investigator.* George D. Scarseth, B.S., *Assistant.*
Tobacco Sub-station at Windsor.	Paul J. Anderson, Ph.D., *Pathologist in Charge.* N. T. Nelson, Ph.D., *Assistant Physiologist.*

THE TUTTLE, MOREHOUSE & TAYLOR COMP

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AUTHORSHIP

For bibliographical purposes, all material in this Report (Bulletin 275) should be credited to W. E. Britton, except where otherwise indicated.

ILLUSTRATIONS

The illustrations in this Bulletin are from the following sources: Figs. 38, 39 and 40 reproduced from printed blanks; Fig. 41, map drawn by Alex. Cahn and shaded by Stoddard Engraving Co.; Figs. 42, 43, 44, 47, 48 and 50 from drawings by Dr. Philip Garman. Fig. 49 drawn by Mr. R. B. Friend. Fig. 45 from photograph by Mr. B. H. Walden. Fig. 46 reproduced from city map. Plates are all from photographs: I, II, III, a, IV, b, V, a, and XII, b, by Dr. W. E. Britton; VI and XX, a, by Dr. Philip Garman; X by Mr. J. L. Rogers; XIV, XV and XVI by Mr. R. C. Botsford; all others by Mr. B. H. Walden.

BULLETIN 275

TWENTY-FIFTH REPORT

OF THE

State Entomologist of Connecticut

To the Director and Board of Control of the Connecticut Agricultural Experiment Station:

I have the honor to transmit, herewith, my twenty-fifth annual report as State Entomologist of Connecticut. As in former years, this report fully covers the activities of the Department of Entomology, as regards the inspection and control work provided for by Statute, and also the various lines of research and observation dealing with economic entomology.

Respectfully submitted,

W. E. BRITTON,
State and Station Entomologist.

INSECT PEST ACCOUNT

REPORT OF RECEIPTS AND EXPENDITURES OF THE STATE ENTOMOLOGIST

FROM JULY 1, 1924 TO JUNE 30, 1925.

RECEIPTS

Insect Pest Appropriation	$15,000.00	
Insect Pest Appropriation, Added by Board of Control	104.22	
Balance on hand July 1, 1924	2,704.52	
		$17,808.74

EXPENDITURES

Salaries	$11,982.02
Labor	2,374.56
Stationery and Office Supplies	228.63
Scientific Supplies (Chemicals)	31.67
Scientific Supplies (Other laboratory supplies)	82.87
Scientific Supplies (Photographic)	81.25
Lumber and Small Hardware	.71

Miscellaneous Supplies*	$544.19	
Automobile Oil	4.15	
Telegraph and Telephone	6.00	
Postage	40.60	
Travel (Outlying Investigations)	294.87	
Travel (Meetings, etc.)	185.97	
Travel (Gasoline for automobiles)	240.14	
Freight, Express and Parcels Post	14.09	
Publications (Bulletins, etc.)	40.53	
Furniture and Fixtures (New)	15.70	
Furniture and Fixtures (Repairs)	14.00	
Library (Books and periodicals)	55.38	
Library (Binding)	7.50	
Scientific Equipment (New)	116.75	
Live Stock (Bees)	1.00	
Tools, Machinery and Appliances (New)	102.60	
Tools, Machinery and Appliances (Repairs)	8.45	
Automobiles (New)	595.50	
Automobiles (Repairs)	349.73	
New Buildings and Structures	35.77	
Insurance (Automobile)	121.29	
Miscellaneous Contingent Expenses	40.00	
Total Disbursements		$17,615.92
Balance in hands of State Comptroller, June 30, 1925		192.82
		$17,808.74

SUMMARY OF INSPECTION AND OFFICE WORK

210 samples of insects received for identification.
160 nurseries inspected.
151 regular certificates granted.
6 special raspberry certificates granted.
57 dealers' permits issued.
107 shippers' permits issued to nurserymen in other States.
143 duplicate certificates furnished to be filed in other States.
118 parcels of nursery stock inspected and certified.
47 bales of mountain laurel and willow (14 trips) inspected and certified for shipment into New York.
112 orchards and gardens examined.
27 shipments, containing 277 cases, 2,977,346 plants, imported nursery stock inspected.
18 shipments, or 66 per cent. found infested with insects or fungi.
766 apiaries, containing 8,257 colonies, inspected.
19 apiaries and 42 colonies found infested with European foul brood.
26 apiaries and 38 colonies found infested with American foul brood.
3,063 letters written on official work.
255 circular letters.
266 post cards.
46 reports to Federal Horticultural Board.
2,504 bulletins, etc., mailed on request or to answer inquiries.
45 packages sent by mail or express.
37 lectures and addresses at institutes, granges and other meetings.

* This includes fuel oil purchased for burning corn stalks and weeds around European corn borer infestations.

PUBLICATIONS OF THE ENTOMOLOGICAL DEPARTMENT, 1925

By W. E. Britton:

Twenty-fourth Report of the State Entomologist of Connecticut (Bulletin 265), 124 pages, 9 figures, 20 plates; 10,500 copies distributed in May.

Inspection of Nurseries in 1924, 8 pages, reprinted from the Report.

Better Care of Shade Trees, Tree Talk, Vol. 6, No. 4, page 4, February, 1925.

Fruit Insects—Important New Ones and Troublesome Old Ones, Report of 31st Annual Meeting, Massachusetts Fruit Growers' Association, Inc., January 7-8, 1925, pp. 118-131, distributed in April.

Report of Committee on Injurious Insects, Proceedings of 34th Annual Meeting, Connecticut Pomological Society, December 11-12, 1924, p. 46, published in 1925.

Recent Developments in Insect Control, Proceedings of 34th Annual Meeting, Connecticut Pomological Society, p. 48.

Insects Attacking Vegetable Crops in Connecticut in 1924, Report of Connecticut Vegetable Growers' Association, p. 43.

The New Law Providing for the Registration and Inspection of Nurseries, Special Bulletin, 500 copies, July 1925.

Regulations Concerning the Shipment of Nursery Stock and the New Law, Bulletin of Immediate Information No. 50, July, 1925.

European Corn Borer Here—Will You Co-operate? Leaflet used in clean-up work around infestations, 6,000 copies, October, 1925.

Regulations Concerning the Transportation of Nursery Stock in the United States and Canada, Bulletin of Immediate Information No. 51, 24 pages, 2,500 copies, October 1, 1925.

By W. E. Britton, G. P. Clinton and W. O. Filley:

Second Report of the Tree Protection Examining Board (Bulletin 263), 52 pages, 8 plates, March, 1925.

By Philip Garman:

Notes on Bee Diseases in Connecticut, Journal of Economic Entomology, Vol. 18, p. 445, June, 1925.

A New Genus and Species of Trombidiidae, Journal New York Entomological Society, Vol. xxxiii, p. 85, June, 1925.

The Oriental Peach Moth Problem, Proceedings of 34th Annual Meeting, Connecticut Pomological Society, p. 57.

By R. B. Friend:

Experience with Baited Traps in Controlling Cabbage Maggots, Report of Connecticut Vegetable Growers' Association for 1924, p. 50.

DEPARTMENT STAFF AND WORK

W. E. Britton, Ph.D., *State and Station Entomologist.*
B. H. Walden, B.Agr., *Photographic and General Work.* } *Assistant Entomologists.*
M. P. Zappe, B.S., *Inspection and General Work.* } *Assistant Entomologists.*
Philip Garman, Ph.D., *Research Work.* } *Assistant Entomologists.*
Roger B. Friend, B. Sc., *Graduate Research Assistant.*
John T. Ashworth, *Deputy in Charge of Gipsy Moth Work.*
James A. McEvoy, *Assistant in Gipsy Moth Work.*
Robert C. Botsford, *Deputy in Charge of Mosquito Work.*
Miss Gladys M. Finley, *Clerk and Stenographer.*
H. W. Coley, Westport, } *Apiary Inspectors.*
A. W. Yates, Hartford, } *Apiary Inspectors.*

There has been no change in personnel of the regular staff since the last Report. Mr. Walden has continued to act as chief photographer of the Department, has taken charge of the office during the absence of the Entomologist, has assisted in scoring fruit in the experiments in spraying and dusting, and has continued his researches on the imported currant worm, *Pteronidea ribesi* Scop.

Mr. Zappe has continued to have charge of the inspection of nursery stock, and of scouting and clean-up work in co-operation with the Federal Bureau of Entomology, on account of the European corn borer. He has collaborated with Dr. Garman in the study of the plum curculio in apple orchards and on the life history and control of the Asiatic beetle, *Anomala orientalis;* with Mr. E. M. Stoddard of the Botany Department in making further tests of various dusts and sprays to control pests of apple orchards, and in making orchard surveys with a view to determining the proper time and materials for treatment.

Mr. J. Leslie Rogers was employed to assist in nursery inspection from July 1 and after the nurseries were completed, was continued on European corn borer clean-up work, during the remainder of the calendar year. Mr. Gerald T. Thompson likewise helped in inspecting nurseries until September 15, when he returned to College. Dr. W. R. Hunt of the Botany Department also assisted in nursery inspection, paying particular attention to plant diseases.

Dr. Garman has continued his investigations on the Oriental peach moth; treatment for the American foul brood of bees; and has made further observations on the European red mite. Jointly with Mr. Zappe, he has continued the investigations on the five-year program begun in 1922, of the plum curculio in apple orchards, and some attention has been given to the Asiatic beetle. Dr. Garman has constantly revised his manuscript on the Odonata or dragonflies of Connecticut, which for some time has been ready, and will later be published as a bulletin of the State Geological and Natural History Survey.

Mr. Friend, who is taking graduate work for the doctorate in Yale University, has continued his studies on the bionomics of the birch leaf skeletonizer, and jointly with the Entomologist has made observations on the imported birch leaf-miner, *Fenusa pumila* Klug., from Europe. Mr. Friend has also given considerable attention to several insects attacking vegetable crops.

The gipsy moth control work has been prosecuted vigorously as in past years by Deputy John T. Ashworth and his Assistant, James A. McEvoy, with headquarters at Danielson. This work is conducted in co-operation with the Federal Bureau of Entomology.

Mr. Botsford has continued to serve as Deputy to Director Slate in charge of mosquito elimination work.

Messrs. A. W. Yates, Hartford, and H. W. Coley, Westport, have continued to inspect apiaries, as in past seasons, on a *per diem* basis.

Miss Finley has continued to perform the necessary clerical and stenographic work of the Department.

The Entomologist has directed the work of the Department and attended to the correspondence of the office; jointly with Mr. Friend he has studied the imported birch leaf-miner; he has continued to serve as Associate Editor of the Journal of Economic Entomology, as Insect Pest Reporter in Connecticut for the Insect Pest Survey of the Bureau of Entomology, and as Chairman of the Tree Protection Examining Board. In October, he was also appointed Superintendent of the State Geological and Natural History Survey.

The more important activities of the Department are described in the various papers in the following pages of this Report.

ENTOMOLOGICAL FEATURES OF 1925

The early part of the season of 1925 was fairly cool and moist and not favorable for plants that thrive best at high temperatures. The first week in June was fair and very hot, and following this period leaf scorch was evident on some kinds of vegetation. After this hot week it was fairly cool for the remainder of the season, with only light rains until September.

One of the outstanding features of the season was the great increase in the Oriental peach moth. The gipsy moth has not spread and the towns of Cheshire and Wallingford have been removed from Federal quarantine. Not a single nest of the brown-tail moth has been seen in Connecticut since 1919.

In order to obtain accurate data regarding the seasonal development of fruit trees and their pests and especially the presence or absence of the latter, Messrs. Zappe and Stoddard made regular visits during May and June to a number of orchards in each county of the State. In all, 39 different orchards were visited; three or four visits were made to certain orchards and 62 visits were made altogether. The data gathered in these visits is used herein.

Fruit Insects

The Oriental peach moth, *Laspeyresia molesta* Busck., was very abundant in some of the orchards in New Haven County and much wormy fruit was the result. One orchard had nearly 50 per cent. of wormy fruit. The pest was not any more abundant in Greenwich than in 1924, but was much more destructive in some

parts of New Haven County. The distribution of this insect in the State has not been fully investigated, but it seems not yet to be present around Storrs or in the eastern portion of the State. Where abundant, its control is a serious problem and is discussed on page 280 of this Report.

The European red mite, *Paratetranychus pilosus* C. & F., was unusually troublesome at Conyer's Farm, Greenwich, and did some damage at Branford, Wallingford and Middlefield. In Branford and Wallingford the mite injured McIntosh, and this is the first time we have ever seen brown leaves on this variety from the attacks of the mite. Some eggs were present on apple at Cheshire, April 2, Milford April 17, Southington April 21, Middlefield April 23, and on European plum at Hazardville, April 7. The best control measure consists in applying a late dormant spray of miscible oil (1-15) to kill the eggs, but failing to give this treatment, persistent spraying of the foliage in summer with dilute lime-sulphur will usually kill enough of the young mites to hold the pest in check.

Work of the pear leaf blister mite, *Eriophyes pyri* Nal., was observed at West Hartford, May 19, and a severe infestation on Bartlett and Seckel was seen at Bantam on May 22. A late dormant spray of lime-sulphur or miscible oil will usually control this pest.

The red-banded leaf-roller, *Eulia velutinana* Walker, was abundant in some orchards and caused considerable injury to fruit as described on page 298. Apparently this pest may be controlled by lead arsenate sprays or dusts as per regular schedule, with an extra application about August 1, in severe infestations.

The apple and thorn skeletonizer, *Hemerophila pariana* Clerck, attracted little attention during the season, though traces of it could be found in nearly every orchard, and the little moths were quite abundant at the Station.

The bud moth, *Tmetocera ocellana* Schiff., was not very troublesome in orchards in 1925, though a few specimens were noticed in Southington May 5. Early applications of lead arsenate will prevent injury.

The red-humped caterpillar, *Schizura concinna* S. & A., was received at the Station from Beacon Falls, August 1, Danbury August 4, Thomaston and Torrington August 19. These caterpillars feed in clusters and strip the leaves from young apple trees in orchard and nursery. Spraying with lead arsenate will prevent defoliation.

The tent-caterpillar, *Malacosoma americana* Fabr., was abundant all over the State, but was seemingly less abundant than elsewhere in Hartford County, particularly in the towns of Simsbury, Windsor, East Hartford, South Windsor and East Windsor. At Wilton, April 20, the young caterpillars had been killed soon after hatching, where a lime-sulphur spray had been applied.

The codling moth, *Carpocapsa pomonella* Linn., still continues to be one of the leading apple pests throughout the State. It is against this insect that arsenical poisons were first used on the apple, and it is the chief reason for their continued application.

The pear psylla, *Psylla pyricola* Foerster, continues to be troublesome wherever pears are grown. Eggs were abundant at Deep River, April 9, and at Southington, April 21-23. The nymphs were killed at Farmington by a spray of lime-sulphur (1-40). None were found in one Wallingford orchard where a delayed dormant miscible oil spray was applied.

Seckel pears in the writer's garden were injured for the first time by curculio larvae. Though the adult has not yet been reared, the injury has been ascribed to the quince curculio, *Conotrachelus crataegi* Walsh, and is described more fully on page 324 of this Report.

Fall cankerworms, *Alsophila pometaria* Harr., were present in abundance and caused injury in many localities. We had occasion to observe them in New Haven, and eggs were seen in East Haven February 19, and in Groton and North Stonington April 9. The caterpillars attack not only fruit trees but also shade and forest trees. The trees on the Station grounds were banded in the fall of 1924, and as these bands were kept in a sticky condition during the emergence of the adults, and at the time when the eggs hatched, the foliage was scarcely mutilated and was not injured. Spraying with lead arsenate early in May will prevent defoliation.

An unusual form of injury was reported from Danbury, May 16, where small flea-beetles were defoliating young peach trees. The species responsible for the injury has green wing-covers, reddish-brown thorax, and has been identified as *Crepidodera rufipes* Linn. Of course trees may be protected by a spray of lead arsenate.

The grapevine flea-beetle, *Altica chalybea* Illiger, injured grapevines at Highwood in April by eating holes into the buds. (Plate IX, b.)

The bumble flower beetle, *Euphoria inda* Linn., was received from Danbury on May 20 and June 5, where it was said to be injuring trees and in one instance it was thought to be the gipsy moth. As a rule the beetles feed upon decaying fruit later in summer and we have no records of their injuring the tissues of trees.

The plum curculio, *Conotrachelus nenuphar* Hbst., was responsible for much injury to apples on unsprayed trees at North Stonington June 11, and at Woodstock June 12. Also in Groton, Montville and Lebanon June 11, all fruit on trees near fences and next to woodland was injured and infested by many larvae. Apples injured by this insect were noticed at Wallingford June 4, Pomfret June 12, Waterbury July 22, East Granby August 18; also on apples and peaches at Rockville June 5, and on cherries at New Britain June 15. The characteristic scars on the fruit were

noticed in the experiments in spraying and dusting in Milford and at the Station orchard at Mount Carmel. The control of this pest is treated more fully on page 286 of this Report, but apparently lead arsenate sprays applied at the time of the pink, calyx, 7-day and 14-day treatments will in most cases produce 90 per cent. of clean fruit in apple orchards, though where possible all rubbish where the beetles hibernate should be removed.

In May, Mr. Walden investigated a case in South Glastonbury where there was a 10 to 15 per cent. injury to strawberry plants by the raspberry fruit worm or raspberry beetle, *Byturus unicolor* Say, described on page 302 of this Report.

Strawberry plants in Coventry, Bolton and Simsbury were injured in May by cutworms eating the leaves. Mr. Walden visited Simsbury and has described the injury elsewhere in this Report.

The apple maggot, *Rhagoletis pomonella* Walsh, continues to be troublesome in many orchards, and infested fruit was received from Waterbury July 22, and from Danbury October 6. It may be controlled by late applications of lead arsenate, about July 4 and July 20.

The rosy apple aphid, *Anuraphis roseus* Baker, was not very abundant in most apple orchards, but was observed in Cheshire May 27, and there were a few in Pomfret and Woodstock on June 12, and in East Granby August 18. It was very bad on one tree in an orchard at Hazardville June 5.

The green apple aphid, *Aphis pomi* DeGeer, was observed in many orchards in spring and early summer. There were very few at Litchfield, Bantam and Cornwall, April 22, at Wallingford Middletown and East Hampton, April 23, at Cheshire May 27 at Greenwich May 14, at South Glastonbury May 5, at Wallingford June 4, and at Woodstock June 12. They were abundant a Southington April 2, 31 being counted on one bud; at Rockvill April 7, Milford April 17, Wilton April 20, Deep River April 9 and on unsprayed tree, Durham, and Southington, May 5, an very abundant at North Stonington June 11. The species wa observed also in Cheshire, Southington and Newington April 2 New Haven April 22, Middlefield April 23, Greenwich March 3 North Stonington April 9, and at Farmington May 6, where spray of nicotine sulphate had knocked off many of the aphi which were still alive and crawling on the ground. At Southin ton May 5, aphids were abundant where lime-sulphur was appli as a dormant spray, but there were few where miscible oil h been used. Also at Yalesville, aphids were present on McInto trees which had been sprayed with lime-sulphur (1-8), nicoti sulphate, and Kayso, but were few where a dormant spray miscible oil had been applied.

The green peach aphid, *Myzus persicae* Sulzer, was present peach trees in some localities and caused the leaves to curl. Th

were few in Cheshire May 27, and though abundant in Rockville, by June 5 all had been cleaned up by natural enemies. In one orchard in Highwood on May 22, the leaves on inside fruit clusters had been badly curled and those on terminal branches were uninjured. Syrphid larvae and lady beetles were abundant, and though we suggested a nicotine dust application for the aphids, could hardly recommend it.

The oyster-shell scale, *Lepidosaphes ulmi* Linn., is one of the commonest pests found in nurseries and is present in many apple orchards. It is usually about the same color as the bark on which it rests, and in shape is elongate, broader at one end than the other, and often curved. Though it occurs on apple, it also infests many shade and woodland trees and seems to prefer poplar, willow, birch, ash, butternut and lilac in Connecticut. There is only one generation each year and it passes the winter in the form of oval white eggs under the old shells on the bark. A spray of nicotine sulphate early in June soon after the eggs hatch is a good remedy.

The San José scale, *Aspidiotus perniciosus* Comst., is more prominent than five or 10 years ago, particularly on untreated trees and shrubs in protected places. It was observed at East Haven February 19, on cherry at Milford August 5, and in West Haven October 14. Orchard trees in Connecticut which are sprayed regularly or occasionally with lime sulphur or with miscible oil do not become seriously infested.

Young pear and apple trees are occasionally injured by a whitish pear-shaped scale known as the scurfy scale, *Chionaspis furfura* Fitch. This scale was noticed at East Haven February 19, by Mr. Zappe. There is one generation each year, and the species passes the winter as oval, purple eggs under the shells. These eggs hatch the last days of May and a spray of nicotine sulphate early in June is the proper remedy.

Vegetable Insects

In reviewing the vegetable insects of the season, we have the advantage of the observations of Mr. A. E. Wilkinson, Vegetable Specialist of the Connecticut Agricultural College at Storrs, who traveled all over the State and visited all the principal vegetable growing sections, and observed the pests and other conditions. Free use is here made of Mr. Wilkinson's reports.

Damage by cutworms was more prominent than usual in most localities, and was severe throughout the State on all kinds of vegetable crops. Reports of injury to vegetables were received from Middletown May 18, from Southington, Waterbury, Thomaston, Morris and Windsor, May 21; from South Norwalk, Easton, Weston, Danbury, Bethel, Brookfield and New Fairfield,

on June 5. In general, a poisoned bait of bran mash distributed about the field will prevent damage from cutworms.

The stalk borer *Papaipema nitela* Guen., was observed in many gardens. It was found in potato stalks at Woodbury, July 31, and was received in corn from Stratford, July 1, Thomaston July 7, Taconic July 21, and Yantic August 4. There is little to do except to remove and destroy the infested stalks.

The corn ear worm, *Chloridea obsoleta* Fabr., though not as abundant as usual, was reported from Mansfield in midsummer and received from East Hartford October 3, and on popcorn from Bridgeport November 3.

The European corn borer, *Pyrausta nubilalis* Hubner, which was discovered at seven points along the Connecticut shore in 1924, and cleaned up around each infestation, is still present in the State. The Federal scouts did not find it in all localities where it occurred last year, but found slight infestations at Bridgeport, Saybrook, New London and at several places in Groton and Stonington. Clean-up work was carried on, but on account of weather conditions could not be completed in Groton and Stonington until spring. This work is described more fully on page 303 of this Report.

The imported green cabbage worm, *Pontia rapae* Linn., was present as usual, though possibly less abundant. It was reported from Windsor May 21, and from Southport, Westport, Easton and Bridgeport on June 2.

The squash borer, *Melittia satyriniformis* Hubner, caused the usual amount of injury to squash and pumpkin vines.

The Colorado potato beetle, *Leptinotarsa decemlineata* Fabr., was not observed to be unusually abundant except on the Station Farm at Mount Carmel, where attention was not given at the proper time. Mr. Wilkinson reported only a few to be seen on June 4, when he visited plantations in South Norwalk, Easton, Weston, Danbury, Bethel, New Fairfield and Brookfield, but that both larvae and adults were plentiful at Southington, Buckland and Wapping on July 24. Of course spraying and dusting with lead arsenate is the remedy.

The cucumber or potato flea-beetle, *Epitrix cucumeris* Harr., was very abundant on potatoes and was also observed on tomatoes and egg-plants at South Norwalk, Easton, Weston, Danbury, Bethel, New Fairfield and Brookfield, June 4, and at Southport, Westport and Bridgeport on June 2. It was present on cucumbers at Windsor Locks, Plainville and Southington, May 21, and on potatoes at Southington, Buckland and Wapping July 24. Thorough spraying with Bordeaux mixture and lead arsenate is probably the best remedy in the field, but a few tomatoes or egg-plants in the garden may be protected by spraying with nicotine sulphate.

The common asparagus beetle, *Crioceris asparagi* Linn., and the twelve-spotted asparagus beetle, *C. duodecimpunctata* Linn., were

present in nearly all large asparagus plantations in the State. They were abundant at Riverton and Southington on May 21, and at South Norwalk, Easton, Weston, Danbury, Bethel, Brookfield and New Fairfield on June 5. The larvae or grubs of the former and the adults of both species feed upon the stems and foliage, but the larvae of the twelve-spotted species feed in the seed pods and do not seriously injure the plants. In severe infestations, the larvae and adults may be killed on the tall or mature plants, by spraying with lead arsenate forced with strong pressure through a nozzle with fine aperture. Nicotine sulphate may be sprayed upon the shoots if the beetles threaten to injure them.

The striped cucumber beetle, *Diabrotica vittata* Fabr., was present in about the usual numbers in most plantations and was controlled only with the usual difficulty. It was reported from Southport, Westport, Easton and Bridgeport, on cucumbers, squashes and melons on June 2. At the Station Farm it was abundant and several treatments were necessary to control the pest. In experiments conducted in various sections of the country, particularly on Long Island and in Canada, calcium arsenate and hydrated lime have given fairly good control, though occasional injury to plants resulted on Long Island. Sodium fluosilicate (1 part) and hydrated lime (9 parts), as well as calcium arsenate and gypsum (1-20), gave good results in Canada. Dr. H. C. Huckett on Long Island found that by mixing No. 2 wheat flour with hydrated lime or gypsum, equal parts, it reduced injury and increased adhesiveness. He also planted squash plants for traps near the cucumbers, then dusted the cucumber plants, thus driving the beetles upon the squash plants, which were then covered and exposed for three minutes to a treatment of four per cent. nicotine dust. This proved effective in destroying the beetles.

The cabbage maggot, *Hylemyia brassicae* Bouché, caused the usual amount of damage and in some localities early cabbages gave only about 50 per cent. of a crop on account of cabbage maggot and cutworms. Cabbage maggot was reported as abundant at Southington and Windsor, May 21; Bridgeport, Southport, Westport and Easton, June 2; Devon, Stratford, Shelton, Cannondale and New Canaan, June 3; South Norwalk, Easton, Weston, Danbury, Bethel, New Fairfield and Brookfield, June 5; Hampton, Canterbury, Brooklyn, Danielson, Pomfret, Woodstock, Norwich, Niantic, Lyme, Waterford, Ellington, Rockville, Vernon, Bolton, Coventry, Tolland, Somers, Stafford and Mansfield, June 12. The flies were noticed about radishes at Plainville, May 21. Mr. Friend observed this insect as severely infesting radishes at Cheshire, and in cabbages at Westport. Probably mercuric chloride or corrosive sublimate (1 ounce in 10 gallons water) is as good a remedy as any, but is known to retard the growth of the plants and consequently more fertilizer should be applied where this treatment is used. It is inadvisable to dip the young plants into

this mixture before setting. In the home garden where only a few plants are grown, tarred paper disks placed flat on the surface of the ground around each plant at the time of setting, will protect them from serious injury.

The spinach maggot or leaf-miner, *Pegomyia hyoscyami* Panzer, which also infests beet and "lamb's quarters," was present in about the usual abundance, though Mr. Friend did not find an infested field suitable for conducting control experiments. This pest was noticed by Mr. Wilkinson at Middletown, May 18, and on beets and spinach at Bridgeport, Southport, Westport and Easton, June 2.

The potato aphid, *Macrosiphum solanifolii* Ashm., was abundant in some sections of the State, and had seriously injured more than 100 acres of potatoes around Middletown by July 21. It was also observed at Stratford, Bridgeport, Westport and Trumbull, on July 19, where some of the vines had turned brown. On July 20, aphids were observed in Windham, Tolland and New London Count·s, and on July 24, they were present in abundance at Southington, Buckland and Wapping. After the rain on July 31, few aphids could be found. Heavy applications of nicotine dust is perhaps the best artificial treatment.

The pea aphid, *Illinoia pisi* Kalt., was present in many fields, but on the whole it did not cause serious injury to peas in Connecticut in 1925. It was reported as being present at Green's Farms June 3, and at South Norwalk, Easton, Weston, Danbury, Bethel, Brookfield and New Fairfield, June 5. Around New Haven, several slight infestations were observed in pea plantations, b·· there was no serious injury brought to my attention. The . aphid caused considerable injury to fields of alfalfa as .escribed on page 295 of this Report. In the home garden, dusting with nicotine is perhaps the best remedy.

The cabbage aphid, *Brevicoryne brassicae* Linn., was present at Middletown May 18, and at East Morris May 21, in both instances on plants from the south. A few were noticed by the writer on home grown plants around New Haven, but they afterward disappeared without doing much damage. Even a moderate infestation will prevent the plants from heading, and liberal applications of nicotine dust will control the aphids.

The turnip aphid, *Aphis pseudobrassicae* Davis, was absent from several turnip patches around New Haven, and no reports were received of injury caused by it.

The tarnished plant bug, *Lygus pratensis* Linn., was reported by Mr. Wilkinson as being very abundant on potatoes at Storrs on July 27. The remedy is to dust or spray with nicotine.

The onion thrips, *Thrips tabaci* Linde., was abundant at Westport, July 19.

The squash bug, *Anasa tristis* DeGeer, was found everywhere as usual. The over-wintering bugs are hard to kill except by crush

ing, but the newly-hatched nymphs may be killed by a spray of nicotine sulphate.

Insects Attacking Field Crops

The army worm, *Cirphis unipuncta* Haworth, was present in some localities and caused considerable injury to timothy grass in Wallingford July 2, and in Milford July 20. Prompt cutting of the grass for hay was recommended as the best treatment in both cases.

White grubs which are the larvae of May or June beetles, *Phyllophaga* sp., were reported as injuring grasslands in a few localities. One report on September 23 of grubs injuring a lawn in Meriden was investigated, thinking it might prove to be the Asiatic beetle, but it was only common white grubs.

The Asiatic beetle, *Anomala orientalis* Waterhouse, which has recently become established in the Westville section of New Haven, caused more injury in the latter half of the summer than has ever been seen before. The grubs eat the roots of grass and thus far the injury has only appeared on lawns around private residences. A more detailed account of this pest may be found on page 309 of this Report.

There was severe injury from attacks of wireworms to newly-set tobacco plants under cloth in Windsor during the last of May. Similar damage was reported by about a dozen tobacco growers. A more detailed account of this outbreak will be found on page 312 of this Report. Mr. Wilkinson reported injury to cabbage plants by wireworms at Middletown, May 18, and at Windsor, May 21.

Alfalfa fields were attacked in Seymour, North Branford, Simsbury, East Windsor, Middletown and Woodbridge by the pea aphid, *Illinoia pisi* Kalt., and a more detailed account is given on page 295 of this Report.

Shade and Forest Tree Insects

The larch leaf-miner or case bearer, *Coleophora laricella* Hubn., was observed in a few places, and specimens were received from Rainbow, May 13. Probably it was less destructive than in 1923 and 1924.

The cottony maple scale, *Pulvinaria vitis* Linn., was received from Hartford on maple, June 29 and July 16.

The tulip tree scale, *Toumeyella liriodendri* Gmel., was received from North Stonington August 28. Two small tulip trees on the Station grounds became infested and were sprayed with commercial liquid lime-sulphur (1-9) in October 1923. This cleaned off most of the infestation but a few scales were present one year

later and the trees were sprayed with one of the miscible oils, and are now clean.

The pit-making oak scale, *Asterolecanium variolosum* Ratz., was received from New Haven December 4, on oak. This scale usually occurs on golden or English oak, *Quercus robur,* and a pit or depression is found in the bark under and around each scale.

The woolly maple leaf scale, *Phenacoccus acericola* King, occasionally causes injury to sugar maple trees, and specimens were received from New Haven on September 30. The large woolly or cotton-like wax masses are found on the under sides of the leaves in midsummer, and contain the mature females and eggs or newly-hatched young. The immature females and the male cocoons are much smaller and occur in the cracks and crevices of the bark of the trunk and lower branches throughout the winter. Spraying in March with lime-sulphur and nicotine has proved to be a satisfactory treatment.

The pine leaf scale, *Chionaspis pinifoliae* Fitch, was received from Southington March 5, Greenwich March 26, Meriden September 24, and Wethersfield October 3. There are two generations each year and two or three applications of nicotine sulphate between June 1 and August 15 should keep this pest in check.

The hickory leaf-stem gall aphid, *Phylloxera caryaecaulis* Fitch, causes certain trees to become very unsightly by forming galls on the petioles of the compound leaves, which often turn brown and drop in midsummer. Specimens were received from Ridgefield June 11, and from Danbury August 21. Though we have conducted no tests for the control of this aphid, probably a spray of miscible oil or lime-sulphur before the buds open would kill the overwintering females or eggs.

A wooly aphid on maple, *Neoprociphilus aceris* (Monell), was received from New Haven, June 22.

The spruce gall aphids, *Chermes abbietis* Linn., on Norway spruce, and *Chermes cooleyi* Gillette, on Colorado blue spruce, seem to be more abundant than was the case a few years ago. The former was received from Marion June 10, Vernon June 16, and from Meriden September 24; the latter from Greenwich March 24, Pine Orchard July 24, and from Norfolk August 8. These pests are found in many of the nurseries and are mentioned on page 237 of this Report. Spraying the trees in April with nicotine sulphate or with a miscible oil will kill the overwintering females before the eggs are laid.

The fall web-worm, *Hyphantria cunea* Drury, was about as abundant as usual in late summer and made its nests on the ends of branches of all kinds of fruit, shade and woodland trees. Apparently it was more abundant than usual in New London County. The only specimens received were from New Haven, August 20. The remedies are to clip off and burn the nests or crush the caterpillars, or spray with lead arsenate.

A small Scolytid beetle, thought to be *Ips pini* Say, was received from Hazardville May 26, tunneling in pine bark.

Sawfly cocoons are often found on pine twigs, and those of the imported pine sawfly, *Neodiprion simile* Hartig, were received from Greenwich March 26, and larvae and pupae of *Neodiprion pinetum* Norton, on red pine were received from Danbury, October 30.

Work of the poplar and willow curculio, *Cryptorhynchus lapathi* Linn., was received from Thompsonville, September 8.

The spruce mite, *Paratetranychus ununguis* Jacobi, was injurious to spruce trees about New Haven and specimens were received from Milford May 23, Stamford July 20, and Meriden September 24. One of the best remedies is a spray of linseed oil emulsion.

The maple bladder gall caused by a mite, *Eriophyes quadripes* Shimer, is seen each year on the leaves of silver maple, and during 1925 specimens were received from Collinsville, June 10, Hartford, June 29, Westport, July 21, and Somers, August 13.

The imported birch leaf-miner, *Fenusa pumila* Klug, now occurs all over Connecticut on gray birch, particularly on young sprouts. Specimens were received from Yalesville, July 15, Leete's Island, July 30, and Norfolk, August 8.

The imported willow leaf-beetle, *Plagiodera versicolora* Laich., which first appeared in the State in Greenwich, has now spread nearly all over Connecticut. Specimens were received from West Haven August 20, and while inspecting nurseries Mr. Zappe observed the presence of this insect in Greenwich, August 11 and 14, Stamford, August 29, New Canaan, August 3, Ridgefield, September 9, and Bristol, September 8.

The elm leaf beetle, *Galerucella xanthomelaena* Schrank, was present and there were many localities where the unsprayed trees were brown in late July and August. Specimens were received from Middlebury, July 16. In many villages the elm trees were sprayed and the foliage kept green throughout the season.

The birch leaf skeletonizer, *Bucculatrix canadensisella* Chamb., though perhaps not so abundant as in 1923 and 1924, was present and caused many areas of gray birch to become brown in late summer.

Household Insects

Nearly every season a certain number of specimens of insects infesting stored food products in or about the household are sent to the Station, and some of those received in 1925 are mentioned here.

The Oriental cockroach, *Blatta orientalis* Linn., was received from Danbury, February 2, and the German cockroach or croton bug, *Blatella germanica* Linn., from Cheshire, April 1. Both species are found in homes, especially around the kitchen and pantry and along the water pipes. Commercial roach powders are now sold everywhere.

The black carpet beetle, *Attagenus piceus* Oliv., is a common pest in houses where the larvae live in floor cracks and feed upon the lint, and the adult beetles eat holes in clothing in closets. Filling or frequent cleaning of the cracks is advisable. Small pieces of woolen cloth placed on the floors in closets will often be eaten instead of the clothing. Specimens of this insect were received from New London, June 10, and from Milford, October 23.

The common carpet beetle or "buffalo bug," *Anthrenus scrophulariae* Linn., was received from Waterbury, October 24. This also injures clothing and particularly carpets on floors. Carbon tetrachloride may be used on infested carpets, or heat generated by applying moisture and going over the carpet with hot flatirons.

The common clothes moth, *Tineola bisselliella* Hummel, was received from New Haven, May 23. Clothes which are worn or moved frequently are usually not injured, and if hung out in the sun about once a month, there is little danger of injury. If this cannot be done, they should be stored at a low temperature, put in moth-proof bags, or packed in naphthalene or camphor.

The granary weevil, *Calendra granaria* Linn., in poultry feed was received from New Haven, September 17; the Mediterranean flour moth, *Ephestia kuehniella* Zeller, in wheat flour from Waterbury, July 17, and the drug store beetle, *Sitodrepa panicea* Linn., in stored grain from New Haven, June 25. These insects are common pests of stored food products, and may be controlled by fumigating or heating the infested products.

The common white ant, *Reticulitermes flavipes* Koll., was received from New Haven, April 17, where it infested the structural wood around the base of a veranda; also the clover mite, *Bryobia praetiosa* Koch, was reported as crawling about on a house in New Haven, May 8.

Miscellaneous Insects

The box leaf-miner, *Monarthropalpus buxi* Labou., was received from Green's Farms, March 16. This is a serious pest of box and has also been recorded from Waterford.*

The juniper web-worm, *Dichomeris marginellus* Fabr., was received from Manchester and West Haven, on June 5, where the caterpillars had injured junipers by webbing the leaves together and feeding upon them inside the web.

Convention of Entomological Workers

The second convention of Entomologists working in Connecticut was held at the Station on October 30, 1925. The pro-

* Report for 1923, page 312.

gram was varied from that of last year by securing addresses from a few men working outside the State on problems which are or threaten soon to become Connecticut problems. Thus we had Mr. L. B. Smith and Dr. Alvah Peterson from New Jersey and Dr. H. C. Huckett from Long Island. Though the attendance was somewhat smaller than last year, there was great interest shown and all present seemed to feel that it had been a successful and interesting meeting. The following program was fully carried out:

PROGRAM

A. M.

Greetings.
W. L. Slate, Jr., Director, New Haven, Conn.
10:15 Notes on the Birch Leaf Skeletonizer.
R. B. Friend, Assistant Entomologist, New Haven, Conn.
10:45 The Asiatic Beetle in Connecticut in 1925.
M. P. Zappe, Assistant Entomologist, New Haven, Conn.
11:15 The Corn Borer Survey of 1925.
L. H. Worthley, In Charge of Control Work, Arlington, Mass.

P. M.

12:30 Luncheon.
1:30 The Japanese Beetle Survey of 1925.
Loren B. Smith, Entomologist in Charge, Riverton, N. J.
2:15 Gipsy Moth Survey of 1925.
A. F. Burgess, In Charge, Melrose Highlands, Mass.
3:00 Progress in Controlling Curculio on Apple in 1925.
Dr. Philip Garman, Assistant Entomologist, New Haven, Conn.
3:30 *Cucumber Beetles.*
Dr. H. C. Huckett, Research Associate, N. Y. Experiment Station, Long Island Branch, Riverhead, N. Y.
4:00 Oriental Peach Moth Survey.
Dr. Alvah Peterson, Bureau of Entomology, Riverton, N. J.
4:30 *Anti-Mosquito* Work of the Season in Connecticut.
R. C. Botsford, Deputy In Charge, New Haven, Conn.
4:45 The Birch Leaf-Miner in the Northeastern States.
Dr. W. E. Britton, State Entomologist, New Haven, Conn.

The following were present: A. F. Burgess, S. S. Crossman, H. L. Blaisdell, T. H. Jones, Melrose Highlands, Mass.; H. A. Ames, Bound Brook, N. J.; S. E. May, Canaan, Conn.; F. C. Rich, Ansonia, Conn.; L. H. Worthley, T. M. Cannon, Arlington, Mass.; Loren B. Smith, J. Peter Johnson, Riverton, N. J.; H. C. Huckett, Riverhead, N. Y.; J. A. Manter, E. W. Nelson, R. S. Filmer, P. E. Bitgood, L. A. Gilbert, J. G. Conklin, Storrs, Conn.; O. W. Spicer, Stamford, Conn.; G. M. Codding, Mount Vernon, N. Y.; P. H. Meagher, Wallingford, Conn.; C. L. Marshall, Meriden, Conn.; D. W. Thomas, 2d, Highwood, Conn.; G. A. Clyne, Waterbury, Conn.; Allen Latham, Norwichtown, Conn.; J. T. Ashworth, Danielson, Conn.; P. L. Buttrick, W. O. Filley, W. L. Slate, Jr., W. E. Britton, Philip Garman, B. H. Walden, M. P. Zappe, R. B. Friend, R. C. Botsford, Leslie Rogers, New Haven, Conn.; Alvah Peterson, Riverton, N. J.

INSPECTION OF NURSERIES IN 1925

The General Assembly of 1925 enacted a new law defining nurseries and nursery stock and providing that all nurserymen register and apply for an inspection each year before July 1; that all dealers register prior to March 1 each year and receive a permit; that all nurseries outside the State wishing to ship nursery stock into Connecticut file copies of their valid inspection certificate and receive permits allowing them to ship stock into Connecticut. The new law is as follows:

The New Law Providing for the Registration and Inspection of Nurseries

Chapter 265, Public Acts of 1925

Section 1. Inspection and Shipment of Nursery Stock: The state entomologist or his deputies or assistants shall, upon application, inspect at least once each year all nurseries at which woody field-grown trees and plants shall be grown for sale or shipment; may inspect any nursery stock when dug, before shipment or at destination; may inspect nurseries at any time for the purpose of controlling plant pests or to ascertain whether such pests exist in nurseries; may employ such deputies or assistants as he may deem necessary; may prescribe forms for registration, certificates and permits and may make rules and regulations regarding time and methods of inspection; may destroy or treat or order the destruction or treatment of, and prohibit the movement of, plants infested with dangerous pests; may co-operate with agents of the United States Department of Agriculture in the inspection of nurseries and control of plant pests; may, at reasonable times, enter any public or private grounds in performance of his duties under the provisions of this act. In case orders shall be issued for the destruction or treatment of infested plants, the owner, manager or agent of the nursery shall, within a reasonable time from the date of such order, destroy such plants as shall be ordered destroyed and make such treatment within the time specified in the order, or be subject to the penalty provided in section five of this act.

Sec. 2. All nurserymen shall register with the state entomologist each year, on or before July first, and make application for inspection, and furnish such data on such blanks as the state entomologist shall prescribe and furnish. In case a nurseryman shall fail to make such application on or before July first, he shall pay to the state entomologist the cost of such inspection. All firms, stores and individuals who shall sell but shall not grow nursery stock, shall be classed as dealers, and shall, each year, on or before March first, register with the state entomologist, giving the chief sources of their nursery stock and such data as he may require, on such forms as he may prescribe and furnish, and the state entomologist may issue a permit allowing such dealer to sell such nursery stock. Each nursery outside the state, before shipping nursery stock into the state, shall file with the state entomologist a copy of a valid inspection certificate and the state entomologist may issue a permit allowing such nursery to ship stock into the state. The state entomologist shall keep a record of all money received as costs for inspection, and such money shall be deposited with the state treasurer.

Sec. 3. The state entomologist shall issue to regular nurseries certificates, valid until the first day of August following the date of issue and covering

the stock inspected and such other stock as shall have been received under valid certificates of inspection; may issue temporary permits covering certain portions thereof, and permits to dealers. All such certificates and permits may be revoked for cause. Nursery stock which shall not have been inspected or stock from a nursery not holding a valid certificate of inspection shall not be sold or transported, and transportation companies shall refuse to accept any shipment not bearing such certificate or some form of permit issued by the state entomologist, and all nurserymen shall furnish a certificate, and all dealers a permit, to accompany each package of stock sold or transported, but no provision of this act shall prevent or render liable any individual or firm who shall transport stock from his field or property to another field or property belonging to or operated by him, when such stock is not to be immediately sold or offered for sale and when such transportation shall not violate any established federal or state embargo or quarantine regulations.

SEC. 4. For the purposes of this act, any place at which hardy trees, shrubs and vines shall be propagated or grown out of doors for commercial purposes, shall be considered a nursery, and such stock shall be regarded as nursery stock; hardy herbaceous perennial plants, including strawberry plants, may be subject to the same provisions regarding inspection and pest control, if, in the opinion of said state entomologist, it shall seem desirable to control the movement of such plants. Florists' ordinary plants, unless woody and field-grown, shall not be included.

SEC. 5. Any person who shall interfere with the state entomologist or his deputy or assistant in the performance of his duties under the provisions of this act, or any person, firm or corporation who shall violate any of the provisions hereof, shall be fined not more than fifty dollars. Any person aggrieved by any order issued under the provisions of this act may appeal to the superior court, or to any judge thereof if said court shall not be in session, and said court or such judge may grant such relief or issue such order or judgment in the premises as to equity may appertain.

SEC. 6. Section 2119 of the general statutes is repealed.

(Approved June 24, 1925.)

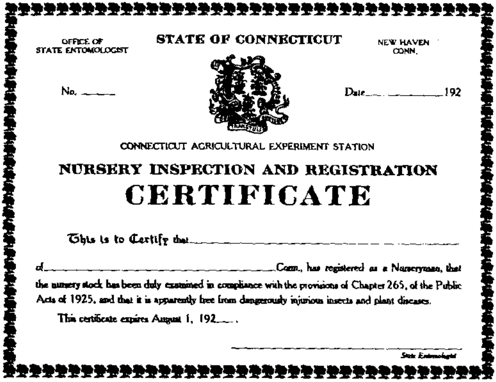
As this act gives the State Entomologist authority to make rules and regulations and to prescribe forms for certificates and permits, the following regulations have been adopted and were printed together with the law as Bulletin of Immediate Information No. 50, under date of July 15, 1925, and a copy sent out with each certificate and permit issued. The forms for certificate and permits are included here for reference. The regulations are as follows:

NURSERY CERTIFICATES

The original certificate issued by the State Entomologist under Chapter 265, Public Acts of 1925, is to be kept in the nurseryman's possession, and is not to be attached to any package of nursery stock. It applies to the whole nursery which has been inspected and to such purchased stock as has been received from other nurseries under the certificate of a state or government officer. If any stock is received from outside the state unaccompanied by such a certificate, the State Entomologist should be notified at once so that it may be inspected.

An exact transcript of the certificate including number and date may be printed on labels or tags for shipping and must be attached to each package sent out of the nursery. An additional statement, made by the owner, that the stock has been fumigated, will be required in many states. The law now requires that the inspection certificate be attached to every package shipped to points both within the State of Connecticut and outside. Please see that a copy always accompanies each sale whether shipped by freight, express, mail, automobile or whether carried away by the purchaser.

After the date of expiration, which is a part of each certificate, the document becomes invalid and should not be attached to any box, bale or package. The nurseryman has no right to change the date or any other portion of the certificate.


OFFICE OF STATE ENTOMOLOGIST

STATE OF CONNECTICUT

NEW HAVEN CONN.

No. _____ Date______________192

CONNECTICUT AGRICULTURAL EXPERIMENT STATION

NURSERY INSPECTION AND REGISTRATION

CERTIFICATE

This is to Certify that______________________________

of____________________________Conn., has registered as a Nurseryman, that the nursery stock has been duly examined in compliance with the provisions of Chapter 265, of the Public Acts of 1925, and that it is apparently free from dangerously injurious insects and plant diseases.

This certificate expires August 1, 192___.

____
State Entomologist

FIG. 38.—Facsimile of nursery inspection and registration certificate, less than two-thirds size.

The improper use or abuse of a certificate will not be tolerated, and the certificate may be revoked for cause.

Duplicate copies of certificates for filing in other states will be furnished on request of the nurseryman.

DEALER'S PERMITS

The original permit issued by the State Entomologist under Chapter 265, Public Acts of 1925, should be kept in the dealer's

possession and is not to be attached to any package or shipment of nursery stock, though copies may be made for this purpose. These may be typewritten or printed and a copy must go with each separate sale from stores, and with each shipment or package of nursery stock transported. This copy must be an exact transcript, and must include number, date of issue and of expiration. After the expiration date, the permit becomes invalid and should not be used. The dealer has no right to alter the date or any other portion of the permit. This permit may be revoked for improper use or abuse, and for not complying with the law.

Shipper's Permits

The shipper's permit is issued to nurserymen in other states who file applications and duplicate signed copies of their state inspection certificates. The original permit should be kept, and a copy (typed or printed) together with a copy of the inspection certificate of the state in which the nursery is situated should accompany each shipment into Connecticut.

Package Certificates

Occasionally individuals and firms not in the nursery business wish to ship a few trees or shrubs but cannot do so without inspection certificates. If such materials can be inspected by our men on their usual trips without extra travel and expense, this will be done on request, as an accommodation. Other inspections may be arranged by special appointment, or plants can be sent to the Station with address and postage for forwarding, and here they will be examined and sent along.

The U. S. Postal Laws and Regulations, Section 467, paragraph 2, governs the mailing of plants and plant products, and reads as follows:

"Nursery stock, including all field-grown florists' stock, trees, shrubs, vines, cuttings, grafts, scions, buds, fruit pits and other seeds of fruit and ornamental trees or shrubs, and other plants and plant products for propagation, except field, vegetable and flower seeds, bedding plants and other herbaceous plants, bulbs and roots, may be admitted to the mails only when accompanied with a certificate from a State or Government inspector to the effect that the nursery or premises from which such nursery stock is shipped has been inspected within a year and found free from injurious insects, and plant diseases, and the parcel containing such nursery stock is plainly marked to show the nature of the contents and the name and address of the sender."

Such materials may be mailed without certificate to any Agricultural Experiment Station or to the United States Department of Agriculture. Florists' plants (not woody, field-grown) and vegetable or other annual herbaceous plants do not require certificates but must be plainly marked as to contents, origin and destination. Package certificates apply only to the contents of

the packages on which they are placed, and the contents of which have been examined.

Quarantines

Both state and Federal quarantines prohibit the movement of nursery stock and forest products from the area quarantined on account of gipsy and brown-tail moths to any point outside of that area, without inspection and certificate. Federal Inspectors will be stationed at convenient points to cover the quarantined area of the state. Applications for such inspections may be made to the nearest Federal Inspector or to the following:

Mr. D. M. Rogers, 408 Atlantic Avenue, Boston, Mass.
In charge of Federal gipsy moth quarantine inspection service.

Dr. W. E. Britton, State Entomologist, Agr. Exp. Sta., New Haven, Conn.
In charge of state gipsy moth quarantine inspection service.

Circular letters were issued to nurserymen and dealers, and notices published in Connecticut newspapers calling attention to the new law and its provisions. The law provides that all nursery certificates shall expire on August 1 of each year. All dealer's permits have been made to expire on December 31, and all shipper's permits are valid during the period covered by the certificates issued to the nurseries by their respective States.

Inspection Work

The annual inspection of growing nursery stock was begun July 7, and most of it was completed by October 15, though a few applied afterward and these inspections were made later. This work was in charge of Mr. M. P. Zappe, who was assisted by Messrs. J. L. Rogers, and G. T. Thompson, and Dr. W. R. Hunt of the Botany Department. Mr. B. H. Walden inspected two nurseries and W. E. Britton, one; Messrs. R. B. Friend and R. C. Botsford, each helped one or two days, and Mr. E. M. Stoddard of the Botany Department helped inspect two nurseries. In one large forest plantation from which trees were sold, Messrs. W. O. Filley, H. W. Hicock, J. E. Riley, Jr., R. Gregory Belcher and Thomas H. Vance of the Forestry Department, assisted.

In addition to the inspections made by the nursery inspectors the gipsy moth scouts were instructed to make careful examina tions for gipsy moth eggs in and around all nurseries in the quar antined area, and to report promptly to the office in case any wer found. No gipsy moth infestations were discovered in or nea any Connecticut nursery in 1925.

In 34 nurseries no important pests were found. A list of inse pests and plant diseases found in nurseries during the annu inspection of 1925, together with the number of nurseries infeste by each, is given below:

List of Pests Found in Nurseries in 1925

Nurseries uninfested	34

Insects

Aphids, apple, green	10
woolly	11
cherry	1
on larch	1
spruce gall,	
Chermes abietis	27
" *cooleyi*	19
on willows	1
Apple and thorn skeletonizer	8
Birch bucculatrix	1
Borer, bronze birch	1
lilac	4
poplar	1
willow	2
Cherry and pear slug	1
Curculio, poplar and willow	1
Elm leaf beetle	5
European pine shoot moth	1
Fall webworm	6
Lace bugs on Crataegus	1
rhododendron	6
Laspeyresia molesta	11
Leafhoppers on apple	18
lilac	1
Mite, box	1
Mite, European red	3
pear blister	9
on silver maple	1
spruce	6
Red-humped caterpillar	2
Sawfly, *Diprion simile*	1
pine	1
Scale, elm	8
oak gall scale (*Kermes*)	2
pitmaking	1
oyster-shell	38
pine-leaf	4
rose	3
San José	32
scurfy	1
tulip tree	6
white elm	1
Tarnished plant bug	2
Tent caterpillar	1
White grubs	1
White pine weevil	5
Willow leaf beetle, Imported	
Plagiodera versicolora	6
Lina scripta	1
Yellow-necked caterpillar	1

Plant Diseases

Apple scab	30
Black knot	1
Brown rot	1
Canker, poplar	34
Crown gall	3
Fire blight	3
Leaf spot on catalpa	3
pear	1
quince	2
rose	6
Mildew on apple	7
catalpa	15
cherry	1
grapes	16
Mildew on horsechestnut	2
lilac	7
rose	33
spiraea	1
Peach yellows	1
Raspberry anthracnose	1
mosaic	6
Rust on hawthorn	1
white pine blister on *Ribes*	7
cedar (on apple)	35
(on cedar)	1
sweet fern (on pine)	1
on willows	1

From an examination of the preceding list it will be seen that the oyster-shell scale still continues to be the commonest pest found in Connecticut nurseries, occurring in 38 of them. The next most common pests in order of their abundance are as follows: cedar rust on apple, 35 nurseries; poplar canker, 34 nurseries; mildew on rose, 33 nurseries; San José scale, 32 nurseries; apple scab, 30 nurseries; spruce gall aphid, *Chermes abietis*, 27 nurseries, and *Chermes cooleyi*, 19 nurseries.

In order to show how the figures of 1925 correspond with those of preceding years, the following table gives the data for the past eight years, as reported by the inspectors:

EIGHT YEAR RECORD OF SERIOUS AND COMMON NURSERY PESTS

Pest	1918	1919	1920	1921	1922	1923	1924	1925
Oyster-shell scale	39	38	38	36	44	42	44	38
San José scale	18	19	11	28	19	20	32	32
Spruce gall aphids	15	19	21	31	21	28	40	27
White pine weevil	5	5	1	1	19	17	5	5
Apple and thorn skeletonizer	..	..	..	..	1	18	2	8
Poplar canker	6	5	13	21	31	34	25	34
Pine blister rust (on *Ribes*)	1	..	..	2	9	6	8	7
Nurseries uninfested	32	32	46	36	36	32	33	34

It may be seen from the table that in 1925, the two species of spruce gall aphids together form the commonest pest in Connecticut nurseries, and must be given some treatment to hold them in check. The oyster-shell scale, however, is and has been for the past eight years the commonest single species pest, though the past season the pine blister rust (on *Ribes*), the poplar canker and the San José scale are not far behind. It is hoped that we can soon issue a bulletin on insect pests of the nursery, giving directions for control, so that the Connecticut nurserymen will know just what treatments will hold these pests in check.

NUMBER OF NURSERIES

The operation of the new law requiring nurserymen to register has brought to light many new nurseries, that heretofore were unknown to the State Entomologist. During the season of 1925, 160 nurseries have been inspected. Of this number 153 have received regular certificates; two of these were inspected twice, once in the spring and again in the fall; three have informed this office since the inspection that they have discontinued the business. Three have been instructed regarding slight infestations, but have not notified this office that the directions have been carried out.

In addition to these inspections and certificates, 118 separate parcels of nursery stock have been inspected and package certificates furnished; also 143 duplicate certificates have been furnished the regular nurserymen for filing in other States.

The total area of Connecticut nurseries in 1925 is about 2,73[illegible] acres, and the list contains 151 names, as follows:

NURSERY FIRMS IN CONNECTICUT RECEIVING CERTIFICATES IN 1925

Name of Firm	Address	Acreage	Certificate Issued	No. of Certificate
Amelunxen & De Wyn	Yalesville	2	Aug. 5	1[illegible]
Baby Blue Spruce Gardens	New Milford	1	Sept. 5	6[illegible]
Barnes Bros. Nursery Co.	Yalesville and Durham	150	Aug. 17	2

Name of Firm	Address	Acreage	Certificate Issued	No. of Certificate
Barnes Nursery & Orchard Co.	Wallingford	50	Oct. 20	129
Barton Nursery	Hamden	1	Sept. 4	60
Benbow, A.	Norfolk	1	Sept. 14	85
Berkshire Nurseries (C. B. Myers, Mgr.)	Milford	10	Dec. 12	150
Bernson, Gosta M.	Cromwell	1	Aug. 5	16
Bertolf Brothers	Greenwich	45	Aug. 21	31
Booy, H. W.	Yalesville	2	Aug. 6	17
Brainard Nursery & Seed Co.	Thompsonville	10	Aug. 26	40
Braley & Co.	Burnside	2	Aug. 24	37
Branford Nurseries (2)	Branford	4	Sept. 5	64
Bretschneider, A.	Danielson	1	Sept. 16	88
Bridgeport Hydraulic Co.	Bridgeport	650	Sept. 28	105
Bristol Nurseries, Inc.	Bristol	20	Sept. 16	87
Brooklawn Conservatories	Bridgeport	1	Sept. 2	55
Brouwer's Nurseries	New London	2	Aug. 20	29
Brown, E. M.	Hartford	2	Oct. 13	122
Burr & Co., C. R.	Manchester	500	July 23	1
Burroughs, Thos. E.	Deep River	4	Sept. 1	46
Cant, Alexander	Springdale	1	Nov. 7	141
Cardarelli, E. J.	Cromwell	2	Aug. 3	10
Chapman, C. B.	Groton	1	Oct. 10	118
Chapman, C. E.	No. Stonington	2	Sept. 2	52
Clinton Nurseries (Warren Richards, Mgr.)	Clinton	2	Sept. 17	91
Conine Nursery Co.	Stratford	50	Aug. 19	26
Conn. Agricultural College (Prof. S. P. Hollister)	Storrs	1	Aug. 21	32
Conn. Agr. Expt. Station (W. O. Filley, Forester)	New Haven	1	Sept. 30	107
Corrigan, James J.	West Haven	1	Sept. 22	101
Courtland Avenue Nurseries (A. Pedersen, Prop.)	Stamford	1	Sept. 10	76
Cross Highway Nurseries	Westport	6	Dec. 10	147
Curtis, E. D.	Bantam	3	Dec. 18	151
Dallas, Inc., Alexander	Waterbury	5	Sept. 21	97
Dawson's Nursery	Willimantic	1	Sept. 14	84
Dowd, Inc., F. C.	Madison	2	Nov. 10	143
Dunlap, Daniel S.	Cromwell	3	Aug. 3	8
Eager, Edward M.	Bridgeport	1	Dec. 5	145
East Rock Nursery (S. Palmieri, Prop.)	New Haven	1	Sept. 12	80
Edgewood Nursery	New Haven	1	Oct. 23	135
Edgewood Nursery, Vidal, Mackintosh, Inc.	Stamford	1	Oct. 10	120
Eells & Sons	Manchester	1	Aug. 13	19
Eldredge, C. F.	Niantic	1	Nov. 18	144
Elm City Nursery Co., Woodmont Nurseries, Inc.	New Haven and Woodmont	100	Aug. 31	42
Elm Grove Cemetery Association	Mystic	1	Oct. 23	132
Engelhardt, Paul	Wallingford	1	Sept. 22	100
Ensign-Bickford Co.	Simsbury	10	Dec. 10	148
Evergreen Nursery Co.	Wilton	12	Aug. 21	30
Fraser's Nurseries	Willimantic	2	Sept. 1	48
Galligan, C. W.	North Haven (Address West Haven)	1	Oct. 14	124

Name of Firm	Address	Acreage	Certificate Issued	No. of Certificate
Gardner's Nurseries	Rocky Hill	22	July 28	4
Geduldig's Greenhouses	Norwich and Ledyard	2	Sept. 10	74
Geremia, Frank	Yalesville	1	Oct. 23	133
Geremia, Joseph	Yalesville	1	Aug. 5	11
Glen Terrace Nursery (J. H. Everett, Prop.)	Mount Carmel	14	Nov. 10	142
Golden Hill Nursery (A. Johnson, Prop.)	Shelton	1	Oct. 2	111
Hanford, R. G.	Norwalk	1	Oct. 2	112
Hansen, Peter	Fairfield	2	Sept. 3	57
Heath & Co.	Manchester	5	July 23	2
Hilliard, H. J.	Sound View	1	July 28	5
Hiti Nurseries (J. H. Bowditch, Prop.)	Pomfret Center	8	Aug. 22	36
Holcomb, Irving	Simsbury	1	Aug. 7	18
Holdridge, S. E.	Ledyard (Address Norwich)	2	Sept. 2	53
Hoogendoorn, C.	Yalesville	1	Aug. 5	14
Horan & Son, Jas.	Bridgeport	2	Sept. 19	95
Houston's Nurseries	Mansfield	10	Oct. 20	130
Hoyt's Sons Co., Inc., The Stephen	New Canaan	400	Aug. 31	43
Hubbard, C. S.	Cromwell	1	Aug. 31	41
Hull, Curtis M.	Wallingford	1	Oct. 23	134
Hunt & Co., W. W.	Hartford	10	Aug. 31	44
Intravaia, Joseph	Middletown	1	Sept. 21	98
Jennings, G. S.	Southport	1	Nov. 3	138
Jones, William	Norwalk	1	Oct. 15	126
Kelley, James J.	New Canaan and Darien	9	Sept. 12	83
Kerner, Eugene	Woodbury	7	Sept. 22	103
Keso Nursery (J. J. Kelsey, Prop.)	Clinton	1	Sept. 4	63
Keystone Nurseries (H. H. Kellner, Prop.)	Danbury	1	Sept. 10	75
Leghorn, John J.	Cromwell	2	Aug. 3	9
Long Hill Nursery (John Eckner, Prop.)	Burnside	1	Oct. 7	115
Malavasi & Son, Sam	New Haven	1	Oct. 19	128
Mallett Co., Geo. A.	Bridgeport	1	Sept. 17	90
Maplewood Nurseries (T. H. Peabody, Prop.)	Norwich	1	Oct. 15	125
Marigold Farm (H. Kelley, Prop.)	New Canaan	5	Oct. 2	108
Marshall, Robert	Wethersfield	1	Oct. 2	110
Meier, A. R.	West Hartford	1	Aug. 22	34
Merwin Lane Nursery	Fairfield	2	Sept. 10	77
Middeleer, Charles	Darien	10	Sept. 19	96
Millane Tree Expert Co.	Middletown	1	Sept. 9	73
Morgan, Wm. F.	No. Stonington (Address Westerly, R. I.)	3	Oct. 13	12[illegible]
New Haven Nurseries (L. A. Soldan, Prop.)	New Haven	1	Oct. 7	11[illegible]
New Haven Park Commissioners (G. X. Amrhyn, Supt.)	New Haven	16	Sept. 9	7
Newington Gardens	Newington	2	Aug. 22	3

Name of Firm	Address	Acreage	Certificate Issued	No. of Certificate
New London Cemetery Assn. (E. E. Rogers, Pres.)	New London	1	Aug. 20	27
New London County Nurseries (W. J. Schoonman, Prop.)	New London	4	Sept. 5	69
New London Greenhouses and Nursery, Inc. (Geo. A. Gorton, Receiver)	New London	1	Oct. 21	131
Nicolson & Thurston	Litchfield	1	Sept. 6	67
North-Eastern Forestry Co. .	Cheshire	40	July 31	7
Norwich Nursery (O. E. Ryther, Prop.)	Norwich	6	Oct. 29	137
Norwood Nursery	Hamden	1	Oct. 3	113
Nott Plant Co.	Meriden	1	Oct. 8	116
Oakland Nurseries	Manchester	5	July 23	3
Outpost Nurseries (L. D. Conley, Prop.)	Ridgefield	50	Sept. 18	93
Ouwerkerk & Van der Stam	Yalesville	15	Aug. 5	13
Park Gardens	Bridgeport	1	Nov. 5	140
Pequod Nursery Co.	Yalesville	15	July 31	6
Perry, Wilfred S.	Waterbury	1	Oct. 2	109
Phelps & V. T. Hammer Co., The J. W.	Branford	2	Sept. 30	106
Pierson, Inc., A. N.	Cromwell	60	Aug. 17	23
Plumley, D. L.	Clintonville	1	Sept. 4	61
Polish Orphanage Farm	New Britain	1	Sept. 11	78
Pomeroy, Edwin C.	Northville	1	Sept. 5	65
Reumann, Theodore	Stamford	1	Oct. 10	119
Ridgefield Florist & Nursery Co. (W. Pinchbeck, Prop.) (2)	Ridgefield	2	Sept. 16	89
Rockfall Nursery Co. (P. Marotta, Prop.)	Rockfall	50	Aug. 13	21
Rowayton Greenhouses, Inc.	Rowayton	1	Sept. 5	70
Rushworth, Edwin	Yalesville	1	Aug. 5	15
Russell, C. B.	Newington	1	Oct. 9	117
Saxe & Floto	Waterbury	1	Oct. 23	136
Schaeffer Bros. Nursery	Ledyard	3	Aug. 17	24
Scheepers, Inc., John	Stamford	14	Sept. 2	56
Scott's Nurseries	Hartford	5	Dec. 8	146
Sierman, C. H.	Hartford	8	Aug. 26	38
Southport Nursery (L. Coari, Prop.)	Southport	10	Aug. 21	33
South Wilton Nurseries	South Wilton	3	Sept. 1	47
State Forest Nursery (A. F. Hawes, State Forester) ..	Weatogue	2	Sept. 12	82
State Street Nursery	New Haven	2	Sept. 1	50
Steck, Chas. A.	Newtown	6	Oct. 13	121
Steck, Harold W.	Farmington	1	Sept. 22	99
Steck, Mrs. Sarah B.	Bethel	1	Sept. 28	104
Stratfield Nurseries	Bridgeport	15	Nov. 3	139
Stratford Florist Co. (C. A. Cooper, Prop.)	Stratford	1	Sept. 12	81
Stratford Rose Nurseries (John Barrow, Prop.) ...	Stratford	1	Sept. 3	58
Sunny Ridge Nursery (C. A. Steck, Jr., Prop.)	Bethel	6	Sept. 22	102

Name of Firm	Address	Acreage	Certificate Issued	No. of Certificate
Szirbik & Co., Geo.	New Haven	1	Oct. 16	127
Tanner's Nursery Co.	Manchester	4	Aug. 26	39
Thomas, D. W.	Highwood	1	Sept. 14	86
Tow Path Gardens (S. W. Eddy, Prop.)	Avon	1	Dec. 10	149
Upson, R. E.	Marion	2	Sept. 17	92
Vanderbrook & Son, Chas. L.	Manchester	11	Aug. 13	20
Van Wilgen Nurseries	Branford	7	Sept. 2	54
Vasileff, Nicholas	Greenwich	1	Sept. 4	62
Verkade's Nurseries	New London, Lyme and Chesterfield	20	Aug. 20	28
Wallace Nursery	Wallingford	5	Sept. 4	59
Wayside Farm Gardens	Thomaston	1	Sept. 5	68
Wheeler, Chas. B.	No. Stonington	2	Sept. 2	51
Wilcox, Harry D.	Avon	1	Sept. 11	79
Wild, Henry	Greenwich and Norwalk	20	Sept. 1	45
Wilson & Co., C. E.	Manchester	75	Aug. 19	25
Woodruff, C. V.	Orange	1	Sept. 18	94
Yale University, School of Forestry	New Haven	2	Sept. 1	49
Zack Co., H. J.	Deep River	5	Sept. 9	72

Total, 151 nurseries ....2,731 acres

Inspection of Raspberry Plantations

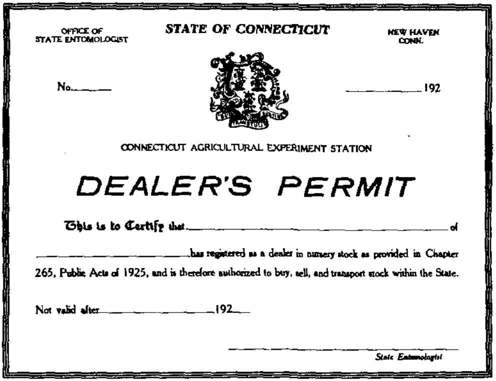
A number of raspberry growers and nurserymen applied for inspections in order to obtain certificates for plants free from mosaic. Consequently two inspections of each were made by Entomologists and Botanists of 11 plantations, mostly in nurseries. Some of these plantations contained too much mosaic to grant certificates, but six special certificates were granted, as follows:

Special Certificates on Raspberry Plants

Name of Firm	Address	Variety	Certificate Issued	No. of Certificate
Barnes Nursery & Orchard Co.	Wallingford	Herbert St. Regis	Sept. 28	7
Burr & Co., C. R.	Manchester	Marlboro St. Regis	Sept. 30	11
Conine Nursery Co., F. E.	Stratford	Cuthbert Kansas St. Regis	Sept. 28	8
Long Hill Nursery (John Eckner, Prop.)	Burnside	St. Regis	Sept. 28	10
Rockfall Nursery Co.	Rockfall	Columbian Cuthbert Kansas Plum Farmer St. Regis	Sept. 28	6
Scheepers, Inc., John	Stamford	LaFrance	Sept. 28	9

Nursery Dealers

As provided by the new law, dealers in nursery stock must also register, and notices and application blanks were sent out to all addresses of dealers that could be obtained, and notices were published in the newspapers, calling attention to the provisions of the new law. As a result, 57 dealers' permits were issued for the six months from July 1, when the new law went into effect, until



OFFICE OF STATE ENTOMOLOGIST

STATE OF CONNECTICUT

NEW HAVEN CONN.

No.______ ____________192

CONNECTICUT AGRICULTURAL EXPERIMENT STATION

DEALER'S PERMIT

This is to Certify that____________________________________of ____________________has registered as a dealer in nursery stock as provided in Chapter 265, Public Acts of 1925, and is therefore authorized to buy, sell, and transport stock within the State.

Not valid after______________192___

____
State Entomologist

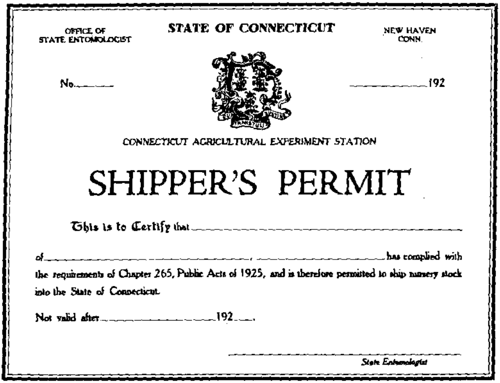
Fig. 39.—Facsimile of dealer's permit, less than two-thirds size.

December 31. These permits were issued only for the remainder of the current year. The list of dealers is not included in this Report, though a facsimile of the permit is shown in Figure 39.

Out-of-State Shippers

Following the provisions of the new law, nurserymen in other states wishing to ship nursery stock into Connecticut are required to file copies of their inspection certificates with the State Entomologist, and receive permits allowing them to ship stock into the State. Application blanks were sent to all nurserymen who filed certificates and to others whom we thought might wish to fill Connecticut orders. The requirements of the new law have also been published in the nursery journals. The permit issued to each

firm covered the same period as the inspection certificate filed by that firm. For the six months from July 1, when the new law became operative, until December 31, 107 such permits have been



OFFICE OF STATE ENTOMOLOGIST

STATE OF CONNECTICUT

NEW HAVEN CONN.

No.______ ____________192

CONNECTICUT AGRICULTURAL EXPERIMENT STATION

SHIPPER'S PERMIT

This is to Certify that ________________________________

of ______________________, ______________________ has complied with the requirements of Chapter 265, Public Acts of 1925, and is therefore permitted to ship nursery stock into the State of Connecticut.

Not valid after ________________192___.

____
State Entomologist

FIG. 40.—Facsimile of shipper's permit, less than two-thirds size.

issued. They are called "shipper's permits" and a facsimile i: shown in Figure 40. The list of nurserymen receiving them i not published in this Report.

INSPECTION OF IMPORTED NURSERY STOCK

The nursery stock entering Connecticut from foreign countrie during 1925 has been fruit and rose seedlings for propagatio This stock has been inspected as in preceding years mostly I Mr. Zappe, though assisted at certain times by Messrs. Wald and Rogers. The number of shipments, cases and plants was le than in 1924, as shown in the table below which gives the statisti for the past six years:

Year	No. of Shipments	No. of Cases	No. of Plants
1920	17	87	814,491
1921	21	126	1,228,560
1922	30	159	1,997,595
1923	35	179	1,981,895
1924	33	313	3,489,170
1925	27	277	2,977,346

These 27 shipments were imported by eight different Connecticut firms, 18 of them being consigned to two firms. Of the total number, 16 shipments contained rose stocks and 10 shipments contained fruit stocks. One shipment contained both fruit and rose stocks.

The time required to inspect this stock is equivalent to one man working 40 days and this time, together with the cost of travel and other necessary expenses, amounts to about $500.00.

Of this material, 1,233,334 plants were rose stocks and 1,754,012 were fruit stocks, the number of each variety being shown in the following table:

FRUIT STOCK

Variety	No. Plants	Total
Apple	755,512	
Apple, dwarf (Doucin)	6,000	
Cherry	545,000	
Pear	195,000	
Plum	191,000	
Quince	61,500	1,754,012

ROSE STOCK

Rosa manetti	1,109,750	
Rosa rugosa	113,584	1,223,334
		2,977,346

Though the greatest number of shipments came from Holland, the greatest number of cases and plants came from France as the following table will show:

SOURCES OF IMPORTED NURSERY STOCK, 1924-1925

Country	No. Shipments	No. Cases	No. Plants
France	10	167	1,904,000
Holland	14	105	999,584
England	2	4	73,750
Canada	1	1	12
	27	277	2,977,346

The following table shows the quantities of stock as inspected by months:

Month	No. Shipments	No. Cases	No. Plants
November	1	2	15,000
December	2	21	217,500
January	8	32	307,734
February	3	34	365,600
March	2	18	180,000
April	8	152	1,701,500
May	3	18	190,012
	27	277	2,977,346

In addition to the material tabulated above, there were 19 iipments containing 25 packages of seeds, mostly of trees and ılms, which were not inspected in Connecticut.

Of the 27 shipments inspected, 18 shipments or 66 per cent, ·ere found infested with insects or plant diseases. One of them, *Iporia crataegi* Linn., on apple and pear stock from France, is onsidered a dangerous insect pest, which should be kept out of he United States if possible. Details regarding the pests dis-:overed in these shipments are given below:

PESTS FOUND ON IMPORTED NURSERY STOCK

18 Shipments Infested.

Insects

Acronycta rumicis Linn., on cherry stock. (1 shipment.) Andre Choplin, Angers, France.

Aporia crataegi Linn., on apple stock. (3 shipments.) Franco-American Seedling Co., Angers, France; Andre Choplin, Maze, France (on pear and apple stock).

Calophasia lunula Hubner, on pear stock. (1 shipment.) Andre Choplin, Maze, France.

Emphytus cinctus Linn., on rose stock. (13 shipments.) Fa. As. Ouwerkerk, Boskoop, Holland; Walter C. Slocock, Woking, England; M. Gielen, Oudenbosch, Holland; Oudyk Bros., Boskoop, Holland; H. H. Woldering, Veendam, Holland; B. Ruys, Ltd., Dedensvaart, Holland; Andre Choplin, Angers, France.

Gelechiidae sp. on cherry. Andre Choplin, Angers, France.

Lepidopterous cocoon, on apple. Andre Choplin, Maze, France.

Leptocryptus lacustris Sch., on quince. Andre Choplin, Angers, France.

Notolophus antiqua Linn., egg mass on apple leaf. (1 shipment.) Franco-American Seedling Co., Angers, France.

Plant Diseases

Crown Gall on rose stocks. (2 shipments.) M. Gielen, Oudenbosch, Holland; Andre Choplin, Angers, France.

INSPECTION OF APIARIES IN 1925

In 1925, as for several years past, the apiary inspection work has been done by Messrs. H. W. Coley of Westport and A. W. Yates of Hartford, on a *per diem* basis. Mr. Coley covers the southern half of the State (Fairfield, New Haven, Middlesex and New London Counties), and Mr. Yates the northern half (Litchfield, Hartford, Tolland and Windham Counties).

This work required a total of 130 man days and the entire cos for the season was $1,881.45.

Fewer apiaries were inspected in 1925 than in 1924, thoug the apiaries averaged slightly larger than last year. The follow ing table shows the number of apiaries and colonies inspecte and the average number of colonies per apiary for each year i Connecticut, since the inspection work was commenced in 1910.

SIXTEEN YEAR RECORD OF APIARY INSPECTION IN CONNECTICUT

Year	No. of Apiaries	No. of Colonies	Average No. Colonies Per Apiary	Average Cost of Inspection Per Apiary	Per Colony
1910	208	1,595	7.6	$2.40	.28
1911	162	1,571	9.7	1.99	.21
1912	153	1,431	9.3	1.96	.21
1913	189	1,500	7.9	1.63	.21
1914	463	3,882	8.38	1.62	.19
1915	494	4,241	8.58	1.51	.175
1916	467	3,898	8.34	1.61	.19
1917	473	4,506	9.52	1.58	.166
1918	395	3,047	7.8	1.97	.25
1919	723	6,070	11.2	2.45	.29
1920	762	4,797	6.5	2.565	.41
1921	751	6,972	9.2	2.638	.24
1922	797	8.007	10.04	2.60	.257
1923	725	6,802	9.38	2.55	.27
1924	953	8,929	9.4	2.42	.25
1925	766	8,257	10.7	2.45	.22

In 1925, apiaries were inspected in 118 towns against 142 in 1924 and 119 towns in 1923.

Inspections were made in the following 16 towns in 1925 which were not visited in 1924: Fairfield County: Bethel; Middlesex County: Saybrook; New London County: Lyme; Litchfield County: Harwinton and New Hartford; Hartford County: Bloomfield, East Granby, East Windsor, Granby, Hartford, Marlborough, Suffield, Windsor and Windsor Locks; Tolland County: Hebron; Windham County: Scotland.

On the other hand, the following 41 towns where inspections were made in 1924, were not visited by the inspectors in 1925: Fairfield County: Brookfield, Fairfield, Monroe, Newtown, Stratford, Trumbull, and Weston; New Haven County: Branford, East Haven, Hamden, Milford, New Haven, North Branford, Orange, West Haven, Wolcott and Woodbridge; Middlesex County: Middlefield; New London County: Ledyard, New London, and North Stonington; Litchfield County: Bridgewater, New Milford, Roxbury, Washington, Woodbury; Hartford County: Enfield, New Britain, Plainville, and Southington; Tolland County: Andover, Ellington, Somers, Stafford, Tolland, Union, Vernon, and Willington; Windham County: Ashford, Eastford, and Pomfret.

European Foul Brood

European foul brood is a bacterial disease of the young larvae caused by *Bacillus pluton*. It is more destructive in spring and early summer than at other periods of the year. The cell contents are usually not gelatinous or ropy, and though the odor of fermentation is generally present, it is not very offensive. The remedy is to requeen the diseased colonies with Italian queens,

and to build up strong colonies by uniting two or more weak colonies if deemed necessary.

Of the 766 apiaries and 8,257 colonies inspected in 1925, 19 apiaries and 42 colonies were found infested with European foul brood. This is 2.48 per cent. of the apiaries and .507 per cent. of the whole number of colonies inspected during the season. This is a somewhat larger percentage of the apiaries and slightly smaller percentage of the colonies than were found infested by this disease in 1924. The following table shows the figures regarding European foul brood since the inspection began in 1910.

RECORD OF EUROPEAN FOUL BROOD

Year	Percentage of Infestation Apiaries	Percentage of Infestation Colonies	Year	Percentage of Infestation Apiaries	Percentage of Infestation Colonies
1910	75.9	49.7	1918	9.8	3.3
1911	51.8	27.4	1919	6.6	1.2
1912	47.7	23.5	1920	4.3	1.5
1913	44.4	24.5	1921	3.91	1.26
1914	32.6	13.9	1922	4.14	.85
1915	26.1	10.3	1923	2.34	.36
1916	18.8	7.05	1924	1.78	.526
1917	16.7	4.86	1925	2.48	.507

During 1925, European foul brood was found only in Naugatuck, New Haven County; Lebanon, New London County; Cornwall, Watertown, and Winchester, Litchfield County; Canton, Granby, Marlborough, and Suffield, Hartford County; Hebron, Tolland County; Plainfield, Putnam, and Sterling, Windham County. None was found in Fairfield and Middlesex Counties.

American Foul Brood

American foul brood is also a bacterial disease of the larvae, caused by *Bacillus larvae*, but it attacks at a later stage of the brood development than does the European foul brood. It usually shows when the larvae are mature and pupating after the cells are sealed. The diseased cells become sunken, and if broken open, the contents have a peculiar ropy or stringy consistency and a very offensive odor. The remedy has been to shake into clear hives, destroy the infected combs, and disinfect the old hives Now it is feasible to sterilize the combs by soaking them in ar alcohol-formalin solution containing 20 per cent. formalin, afte which they can safely be used.

Of the 766 apiaries and 8,257 colonies inspected in 1925, 2 apiaries and 38 colonies were found diseased with American foı brood. This is 3.26 per cent. of the apiaries and .446 per cent. c the whole number of colonies inspected in 1925. This is a som what larger percentage of infestation than has been found fc several years, as the following table will show:

RECORD OF AMERICAN FOUL BROOD

Year	Percentage of Infestation Apiaries	Percentage of Infestation Colonies	Year	Percentage of Infestation Apiaries	Percentage of Infestation Colonies
1910	0	0	1918	1.01	.32
1911	0	0	1919	3.	1.1
1912	0	0	1920	1.18	.25
1913	0	0	1921	2.5	.56
1914	1.07	.7	1922	1.38	.27
1915	.8	.18	1923	.965	.323
1916	1.07	.15	1924	1.04	.22
1917	.42	.17	1925	3.26	.424

During 1925, American foul brood was found in Ridgefield, Stamford and Wilton, Fairfield County: Meriden, Wallingford, and Waterbury, New Haven County; Cromwell and East Haddam, Middlesex County; Norwich, New London County; Litchfield, Plymouth, and Torrington, Litchfield County; Andover, Tolland County; and Bristol and Manchester, Hartford County. None was found in Windham County.

Sacbrood

Sacbrood or pickled brood is a disease caused by a filterable virus, and is often mistaken for European or American foul brood. The larvae die about the time the cells are capped and lie on their backs with heads turned upward. The color, though variable, is often light yellow or brown with head nearly black. The body is swollen and the contents are watery, but there is no ropiness. The entire cell contents can readily be removed intact as if enclosed in a sac.

Treatment for sacbrood consists in keeping bees from contact with infected honey, frames and hives, and in uniting weak colonies to make strong ones.

In 1925, sacbrood was found in 26 apiaries and 69 colonies. This is 3.39 per cent. of the apiaries, and .83 per cent. of the colonies examined.

RECORD OF SACBROOD

Year	Percentage of Infestation Apiaries	Percentage of Infestation Colonies	Year	Percentage of Infestation Apiaries	Percentage of Infestation Colonies
1910	0	0	1918	.253	.032
1911	..	.51	1919	1.24	.19
1912	..	Several	1920	1.18	.229
1913	..	2.8	1921	1.06	.157
1914	2.59	.721	1922	1.37	.187
1915	2.02	.47	1923	.53	.086
1916	.428	.051	1924	1.78	.52
1917	1.48	.199	1925	3.39	.836

Paralysis

Adult bees are sometimes sickly, and are said to have paralysis. The cause may be poisoning or several other conditions, and it is

usually impossible to give advice regarding treatment, particularly until more is known about symptoms and conditions concerning the apiary.

Statistics of Inspection

The statistics of apiary inspection by towns and counties may be found on the following pages, with summary on page 253.

Town	Apiaries		Colonies		Foul Brood			
	Inspected	Diseased	Inspected	Diseased	American	European	Sacbrood	Paralysis
Fairfield County:								
Bethel	4	0	32	0	0	0	0	0
Danbury	2	1	44	8	0	0	8	0
Darien	7	1	46	1	0	0	0	1
Easton	4	0	91	0	0	0	0	0
Greenwich	28	3	206	7	0	0	7	0
New Canaan ..	12	1	103	6	0	0	6	0
Norwalk	6	0	53	0	0	0	0	0
Redding	2	0	8	0	0	0	0	0
Ridgefield	4	1	16	1	1	0	0	0
Shelton	1	0	28	0	0	0	0	0
Stamford	35	4	333	8	5	0	3	0
Westport	1	0	7	0	0	0	0	0
Wilton	6	1	123	1	1	0	0	0
	112	12	1,090	32	7	0	24	1
New Haven County:								
Beacon Falls ..	2	0	27	0	0	0	0	0
Cheshire	7	0	81	0	0	0	0	0
Derby	3	1	22	1	0	0	1	0
Guilford	2	0	28	0	0	0	0	0
Madison	2	1	26	1	1	0	0	0
Meriden	24	0	195	0	0	0	0	0
Naugatuck	2	2	31	6	0	3	3	0
North Haven ..	5	0	45	0	0	0	0	0
Prospect	2	0	16	0	0	0	0	0
Seymour	2	1	36	1	0	0	1	0
Wallingford ..	26	6	174	14	4	0	10	0
Waterbury	2	1	89	3	3	0	0	0
	79	12	770	26	8	3	15	0
Middlesex County:								
Chester	8	1	80	2	0	0	2	[illegible]
Clinton	5	4	62	19	3	0	16	[illegible]
Cromwell	2	0	66	0	0	0	0	[illegible]
Durham	8	2	98	3	2	0	0	
East Haddam..	7	0	120	0	0	0	0	
East Hampton.	14	0	166	0	0	0	0	
Essex	4	1	72	2	0	0	2	
Haddam	4	0	68	0	0	0	0	
[illegible]	[illegible]	[illegible]	[illegible]	3	0	0	3	

Town	Apiaries Inspected	Apiaries Diseased	Colonies Inspected	Colonies Diseased	Foul Brood American	Foul Brood European	Sacbrood	Paralysis
Middlesex County—*cont.*:								
Middletown ...	5	1	27	1	0	0	0	1
Old Saybrook..	8	1	72	2	0	0	2	0
Portland	5	0	38	0	0	0	0	0
Saybrook	2	0	9	0	0	0	0	0
Westbrook	1	1	4	1	0	0	1	0
	71	12	891	33	5	0	26	2
New London County:								
Bozrah	4	0	142	0	0	0	0	0
Colchester	11	0	78	0	0	0	0	0
East Lyme	3	0	59	0	0	0	0	0
Franklin	2	0	104	0	0	0	0	0
Griswold	5	0	130	0	0	0	0	0
Groton	6	1	61	1	0	0	1	0
Lebanon	7	1	140	1	0	3	0	0
Lisbon	2	0	32	0	0	0	0	0
Lyme	2	0	96	0	0	0	0	0
Montville	5	0	53	0	0	0	0	0
Norwich	9	2	440	5	4	0	1	0
Old Lyme	2	0	52	0	0	0	0	0
Preston	3	0	38	0	0	0	0	0
Salem	2	0	44	0	0	0	0	0
Sprague	1	0	16	0	0	0	0	0
Stonington	7	0	83	0	0	0	0	0
Voluntown	2	0	25	0	0	0	0	0
Waterford	2	1	45	1	0	0	1	0
	75	5	1,638	8	4	3	3	0
Litchfield County:								
Barkhamsted ..	6	1	37	2	0	2	0	0
Bethlehem	6	1	22	3	0	3	0	0
Canaan	1	0	7	0	0	0	0	0
Colebrook	5	0	34	0	0	1	0	0
Cornwall	9	1	70	1	0	0	0	0
Goshen	7	0	81	0	0	0	0	0
Harwinton	7	0	40	0	0	0	0	0
Litchfield	12	1	214	2	2	0	0	0
Morris	4	0	39	0	0	0	0	0
New Hartford.	13	0	76	0	0	0	0	0
Norfolk	4	0	25	0	0	0	0	0
North Canaan .	4	0	80	0	0	0	0	0
Plymouth	3	1	21	1	1	0	0	0
Salisbury	6	0	43	0	0	0	0	0
Sharon	3	0	102	0	0	0	0	0
Thomaston	7	0	35	0	0	0	0	0
Torrington	16	1	95	1	1	0	0	0
Watertown	13	1	78	2	0	2	0	0
Winchester ...	15	1	96	2	0	2	0	0
	141	8	1,195	14	4	10	0	0

Town	Apiaries Inspected	Apiaries Diseased	Colonies Inspected	Colonies Diseased	Foul Brood American	Foul Brood European	Sacbrood	Paralysis
Hartford County:								
Avon	4	0	32	0	0	0	0	0
Berlin	12	0	183	0	0	0	0	0
Bloomfield	6	0	143	0	0	0	0	0
Bristol	14	1	74	5	4	0	1	0
Burlington	7	0	47	0	0	0	0	0
Canton	16	1	99	5	0	5	0	0
East Granby	6	0	33	0	0	0	0	0
East Hartford	5	0	25	0	0	0	0	0
East Windsor	1	0	19	0	0	0	0	0
Farmington	4	0	18	0	0	0	0	0
Glastonbury	13	0	166	0	0	0	0	0
Granby	3	1	39	2	0	2	0	0
Hartford	3	0	22	0	0	0	0	0
Hartland	1	0	125	0	0	0	0	0
Manchester	14	1	110	3	3	3	0	0
Marlborough	2	1	41	3	0	0	0	0
Newington	1	0	9	0	0	0	0	0
Rocky Hill	4	0	32	0	0	0	0	0
Simsbury	7	0	55	0	0	0	0	0
South Windsor	3	0	33	0	0	0	0	0
Suffield	14	2	102	3	0	3	0	0
West Hartford	20	0	165	0	0	0	0	0
Wethersfield	11	0	62	0	0	0	0	0
Windsor	17	0	80	0	0	0	0	0
Windsor Locks	7	0	27	0	0	0	0	0
	195	7	1,741	21	7	13	1	0
Tolland County:								
Andover	1	1	6	3	3	0	0	0
Columbia	5	0	34	0	0	0	0	0
Coventry	6	0	81	0	0	0	0	0
Hebron	4	1	24	2	0	2	0	0
Mansfield	1	0	8	0	0	0	0	0
	17	2	153	5	3	2	0	0
Windham County:								
Brooklyn	4	0	190	0	0	0	0	0
Canterbury	3	0	33	0	0	0	0	[illegible]
Chaplin	3	0	21	0	0	0	0	[illegible]
Hampton	9	0	87	0	0	0	0	[illegible]
Killingly	7	0	32	0	0	0	0	[illegible]
Plainfield	20	3	108	9	0	9	0	[illegible]
Putnam	5	1	49	1	0	1	0	[illegible]
Scotland	7	0	24	0	0	0	0	[illegible]
Sterling	2	1	6	1	0	1	0	[illegible]
Thompson	6	0	70	0	0	0	0	[illegible]
Windham	7	0	86	0	0	0	0	[illegible]
Woodstock	3	0	73	0	0	0	0	[illegible]
	76	5	779	11	0	11	0	[illegible]

SUMMARY

County	No. Towns	Apiaries Inspected	Apiaries Diseased	Colonies Inspected	Colonies Diseased	Foul Brood American	Foul Brood European	Sacbrood	Paralysis
Fairfield	13	112	12	1,090	32	7	0	24	1
New Haven	12	79	12	770	26	8	3	15	0
Middlesex	14	71	12	891	33	5	0	26	2
New London	18	75	5	1,638	8	4	3	3	0
Litchfield	19	141	8	1,195	14	4	10	0	0
Hartford	25	195	7	1,741	21	7	13	1	0
Tolland	5	17	2	153	5	3	2	0	0
Windham	12	76	5	779	11	0	11	0	0
	118	766	63	8,257	150	38	42	69	3

	No. Apiaries	No. Colonies
Inspected	766	8,257
Infested with European foul brood	19	42
Per cent. infested	2.48	.507
Infested with American foul brood	26	38
Per cent. infested	3.26	.446
Infested with sacbrood	26	69
Infested with bee paralysis	3	3
Average number of colonies per apiary		10.7
Cost of inspection		$1,881.45
Average cost per apiary		2.45
Average cost per colony		.22

REPORT OF THE GIPSY MOTH WORK

Year Ending June 30, 1925.

By John T. Ashworth and W. E. Britton.

This work has been carried on as in preceding years by State and Federal agencies working in close and friendly co-operation.

The Federal agencies have scouted the towns near and outside the margin of the infested area in order to prevent further spread, and the State appropriation for the most part has been expended within the area known to be infested. This close co-operation has rendered the work far more effective than could possibly result if both agencies worked independently. We hereby express our appreciation and thanks to Mr. A. F. Burgess and his assistant, Mr. H. L. Blaisdell, of the Bureau of Entomology.

In the following pages will be found a brief account of the work done by both State and Federal forces in each town, arranged by counties. Under towns is mentioned only the number of infestations sprayed, but the amount of spraying done in each town may be learned from the table of statistics, pages 267-269, where the quantities of poison used are given (25 pounds of lead arsenate make 400 gallons of spray mixture).

A report on larvae and pupae is also given in the tables; scouting for larvae is done both before and after spraying, around the colonies discovered during the winter. Most of the larvae here reported were found before spraying, and all such larvae and pupae were killed by hand.

New Equipment

Duing the year ending June 30, 1925, considerable new equipment was bought and some of the old renewed: 1,500 feet of new spray hose was purchased from the Acme Rubber Company, and a saving of ten cents per foot effected by using couplings from old or leaky hose. The old Corona typewriter was turned in as part payment for a guaranteed second-hand Remington machine. The old Ford touring car was exchanged toward a new Dodge touring car. The two oldest Ford trucks were also turned in and replaced with new ones; three new Ford trucks were added to the fleet, which now numbers nine Ford delivery trucks and one Dodge and one Buick, both touring cars. A Ford Dealer's cabinet with repair parts, one electric drill, one portable auto jack, and several small tools, such as wrenches, drills, screw drivers and hammers, have been added to the storehouse equipment.

Details of the Work by Towns

The following pages give a detailed account of the conditions in each town where work was done.

WINDHAM COUNTY

Brooklyn—27 Infestations—903 Egg-clusters.

Brooklyn was scouted during September and October by State men. The town was found to be generally, although not heavily infested. Egg-clusters were found in 57 different places (counting single egg-clusters and colonies). At three of the colonies 407 or almost half of the total number of egg-clusters were found Two of these infestations were found on land owned by Mı Benham, in the southern or Wauregan corner of the town; on colony was found in woodland and a stonewall, the other in a orchard; 268 egg-clusters were found at these two places. Or other large colony was found in an orchard owned by Mr. Salmc on Allen Hill. These three and 13 other colonies were spraye in June by State men.

Killingly—43 Infestations—1,676 Egg-clusters

Killingly was used this year as a school in which to train m in this work for the Federal Bureau, as well as for the Sta Most of the infestations found in the town were small for t

territory; there were only three colonies of over 100 egg-clusters each. One of these was found in a stonewall on land owned by Lewis Pringle, situated on the west shore of Old Killingly pond, and contained 290 egg-clusters. Another colony of 120 egg-clusters was found in an apple tree owned by Hiram Franklin, just south of Danielson, on what is known as the Green Hollow road. The last colony to be mentioned was one of 101 egg-clusters, found on a white oak and in a stonewall in Dayville on land owned by Stanley King. Twenty-one colonies were sprayed in May by a State crew.

PLAINFIELD—21 INFESTATIONS—428 EGG-CLUSTERS

In Plainfield as in Killingly, the scouting was done by men who were being trained, both State and Federal men doing the work. Only two important colonies were found in the town. The largest was a colony of 101 egg-clusters in white oak growth near the north end of Moosup pond, owner unknown. The other was in shade trees and a stonewall on land owned by S. H. Dolly, about one mile east of Plainfield village, where 89 egg-clusters were found, most of them in the stonewall and all but one being old egg-clusters. Twelve of the colonies were sprayed by State men in June.

POMFRET—71 INFESTATIONS—2,109 EGG-CLUSTERS

Pomfret was scouted early in the year by State crews. As in the last two years, infestations occurred in all parts of the town. About one-fourth of the total number of egg-clusters found were old ones (or hatched). Several infestations were found in stonewalls, but most of them were in woodland; the percentage of orchard infestations was very small in Pomfret this year. There were only three colonies where more than 100 egg-clusters were found; the largest was one of 436 egg-clusters, 191 trees in woodland owned by Mr. Wetherbee in the extreme southwestern corner of the town being infested. The next largest colony was in two white oaks owned by Mr. McGinnes, about one mile east of Pomfret station, where 280 egg-clusters were found. Another colony of 114 egg-clusters was found in woodland and a stonewall on land owned by Howard White, near Pomfret Landing. Twenty-four infestations were sprayed in June by State men.

PUTNAM —68 INFESTATIONS—1,956 EGG-CLUSTERS

Scouting in Putnam was completed October 31, and the results showed the town to be infested in about the same degree as last year. There were four colonies of more than 100 egg-clusters each, and four colonies of between 50 and 100 egg-clusters; the

other colonies were mostly small ones. One of the largest colonies was in three oak trees and a stonewall on land owned by Jerome Shippee, near the Putnam Town Farm, containing 189 egg-clusters. Another of 195 egg-clusters was found in an orchard owned by Miss Bertha White, on the State road to Providence, just east of the Windham County Home. One of 127 egg-clusters was found on one white oak in a pasture owned by H. D. Dimond, in the East Putnam district. The fourth colony of 105 egg-clusters was found in a pasture owned by Frank E. C. Pearce; the egg-clusters were in one oak, one hickory and in a stonewall. Forty-two of the infestations were sprayed by State men during May and June.

Scotland

Scotland was scouted by a State crew the last of the season when the foliage was about half grown. This made the work slow and difficult, but the entire town was scouted and no infestations found.

Sterling—2 Infestations—82 Egg-clusters

Federal men who were being trained scouted Sterling this year, and only two colonies of more than five egg-clusters each were found; both were in orchards near the Rhode Island line, just north of the railroad. One orchard was owned by A. Gibson, the other by H. M. Cook, and contained 11 and 16 egg-clusters respectively. Single egg-cluster infestations were scattered through the town, the greater portion being in the northern part. Both colonies were sprayed June 2 by State men.

Thompson—103 Infestations—5,256 Egg-clusters

In Thompson as in several towns in Windham County, the scouting was done by Federal men who were learning to do the work. The town was found infested throughout, and only three of the largest colonies are mentioned. One of 200 egg-clusters was found on roadside oaks near North Grosvenordale; another of 175 egg-clusters was found in one apple tree in a pasture owned by A. J. Barvia, near the railroad just north of West Thompson station. A colony of 153 egg-clusters was found in an orchard and oak woodland owned by John Andrews in North Grosvenordale. By the time the spraying crews reached Thompson, the larvae were nearly full-grown, so only 22 of the infestations were sprayed before the work stopped. Spraying and scouting for larvae was done by State men.

Woodstock—41 Infestations—3,902 Egg-clusters

About two-thirds of Woodstock was scouted by Federal men late in the year; in fact egg-clusters were hatching when the work was stopped. None of the colonies found were considered large for this territory. At the largest colony, 58 egg-clusters were found on one elm tree and in a stonewall, in the southeastern corner of the town. Another of 54 egg-clusters was found in an orchard owned by E. J. Cortiss, in the village of East Woodstock. The next largest colony was one of 26 egg-clusters in an orchard owned by Margaret Potter, on the road leading north from North Woodstock near the Massachusetts line. All the other colonies had less than 25 egg-clusters each, and 15 colonies were sprayed by State men.

NEW LONDON COUNTY

Colchester—5 Infestations—394 Egg-clusters

Colchester was scouted by State men and completed on April 28. Five infestations were found, all of them in the eastern half of the town. Two were large colonies for this territory; the largest contained 325 egg-clusters in woodland owned by Edward Brown, about two miles south of Colchester village. The other colony was about one mile eastward in oak and hickory trees on land owned by Nicholas Clement, where 52 egg-clusters were found. These and two other small infestations of eight egg-clusters each were sprayed by a State crew, about the middle of June.

Franklin—5 Infestations—18 Egg-clusters

Five infestations were found in Franklin by State men, all of them being very small ones. The largest was a colony of nine egg-clusters found in one white oak on land owned by B. Bogacink, about one mile west of Franklin, on the road leading to North Franklin. At each of the other infestations, three egg-clusters or less were found. Two places were sprayed in June by a State crew.

Griswold—3 Infestations—54 Egg-clusters

About two-thirds of Griswold was scouted, the time being insufficient to complete the town. About 37 miles of roadside were covered and three infestations found; one of 51 egg-clusters was in an old apple tree on roadside, in the Pachaug district; another of two egg-clusters was found in two trees (one maple and one elm) on land owned by Ora Askholm, in the extreme northwestern corner of the town; the third of one egg-cluster in an apple tree owned by F. Peterstrom, about one mile south of

Glasko village. Two places were sprayed by State men on June 15.

Groton—2 Infestations —27 Egg-clusters

A training school for the Federal Bureau was started in Groton, continued for several days, and a part of the town scouted and only two infestations found. This region proved to be too sparsely infested for training recruits, and the school was discontinued. One colony of 17 egg-clusters was found in an orchard in Mystic village owned by Charles Benjamin; the other had 10 old egg-clusters in apple and plum trees owned by H. Shaughness near Eastern Point. One colony was sprayed on June 17 by State men.

Lisbon

No scouting was done in Lisbon this year except for larvae. This work was taken up in July after the spraying stopped. As no infestations were found, the men were sent to look over last year's colonies. At one of these, larvae and pupae were found, so every tree around this colony was climbed and thoroughly examined; 285 larvae and pupae were found and destroyed by State men.

Salem

Salem was scouted the last of the season by a State crew and no infestations found.

Stonington—1 Infestation—19 Egg-clusters

The work done in Stonington this year was of the same character as that done in Groton; only one colony and five single egg-cluster infestations were found; then the men were transferred to Thompson. The colony was in white oaks in a pasture owned by Mr. Cash Miller, about one mile south of Stillmanville, and contained 14 egg-clusters. Five single egg-cluster infestations were found scattered in and around the village of Stonington. The colony was sprayed on June 16 by a State crew.

TOLLAND COUNTY

Andover—1 Infestation—30 Egg-clusters

A State crew completed the scouting in Andover on April 20. One colony of 30 egg-clusters was found in one apple tree on land owned by D. Fox, on the south side of the railroad near the Columbia line. This colony was sprayed on June 27 by State men.

Bolton—1 Infestation—26 Egg-clusters

This town was scouted by State men during February and March and one colony of 26 egg-clusters found. This was in woodland owned by Sam Alavoid, about one mile east of Bolton village. Two acres of woodland were sprayed by State men on June 27.

Columbia—2 Infestations—175 Egg-clusters

Two colonies were found in Columbia this year by State men, both in the southwestern part of the town near the Hebron town line on land owned by False Keosenity. One was found in apple trees scattered along the roadside and contained 46 egg-clusters; the other was in woodland where 129 egg-clusters were found. Eighty-eight apple trees and 29 shade trees were sprayed at one colony and one and one-half acres of woodland at the other by State men on June 26.

Ellington—11 Infestations—97 Egg-clusters

Seven of the 11 infestations found in Ellington this year were on or near the State road from Vernon to Somers; none of them were large and only four are mentioned here. The largest infestation contained 28 egg-clusters. This colony was found in apple trees owned by H. Schuldenfrei on the east side of the State road near the Somers town line. Another of 21 egg-clusters was found on a white oak in the margin of woodland owned by Frank Goodiza, about one and one-half miles directly east of the colony just mentioned. One of 17 egg-clusters was found on a white oak owned by Clem Clark, near Ellington depot and another of 14 egg-clusters in a white oak in the northwestern part of the town. Seven of the places were sprayed by State men the latter part of June.

Hebron—1 Infestation—12 Egg-clusters

One colony of 12 egg-clusters was found by State men in Hebron this year, in maple and hickory trees and also a stone-wall along the roadside in the village of Gilead on property owned by H. D. Hodge. This colony was sprayed by State men on June 25.

Somers—16 Infestations—81 Egg-clusters

Somers was scouted by State men, and the work completed on November 15. Sixteen infestations were found scattered in the four corners of the town, with nothing in the center. All the colonies were small and were mostly in apple trees. The largest colony was one of 17 egg-clusters in apple trees owned by Jos.

Pelcozasski, near the Massachusetts line. Another of 15 egg-clusters was found on two oaks owned by M. Keeney, in the village of Somerville. These two colonies were the largest, and most of the others were single egg-cluster infestations. Six of the places were sprayed in June by State men.

Stafford—55 Infestations—1,290 Egg-clusters

Several large colonies were discovered in Stafford this year by State men. The largest contained 225 egg-clusters on a white oak and an apple tree in a field owned by Fred Ramyoni, about one and one-half miles north of Orcuttville. Another of 117 egg-clusters was found in an orchard owned by Charles Stebbens, in the northwestern corner of the town. A colony of 93 egg-clusters was found in apple and oak trees and a stonewall owned by Mr. Sartonia, just east of Staffordville post office. There were 10 other colonies of between 30 and 40 egg-clusters each. Thirty-four places were sprayed late in June by State men.

Vernon—2 Infestations—47 Egg-clusters

Vernon was scouted by State men, the work being completed on February 7. Two infestations were found; one, a single egg-cluster, on a white oak, on town property in the village of Rockville. The other contained 46 egg-clusters found in four white oak trees on land owned by Otto Broll, near the center of the town. This colony was sprayed by State men on June 29.

HARTFORD COUNTY

Avon

The work in Avon was confined to the territory around last year's infestation. Three miles of roadside and several acres of woodland were scouted and no egg-clusters found.

Berlin

Berlin was scouted by State men and the work finished on May 14. No infestations were found.

Bloomfield—3 Infestations—25 Egg-clusters

State men finished scouting in Bloomfield on January 5. Three small infestations were found; one was a colony of 11 egg-clusters on oak and ash trees in a pasture owned by J. G. Hawley, just east of the railroad on State road leading from Bloomfield to Blue Hills Avenue, Hartford. Another colony of 11 egg-clusters was found one mile further south on the east side of the

railroad in apple trees owned by A. Corte & Son. The third was a colony of three egg-clusters found on oaks owned by Mr. Fuller, near the Simsbury line on the south side of the State road leading from Bloomfield to Simsbury. Two places were sprayed on June 17 and 18 by State men.

East Granby—2 Infestations—8 Egg-clusters

The two infestations found this year in East Granby were both reinfestations. At Mr. Vitten's place just north of the post office, eight egg-clusters were found on willow trees. Larvae were found at Mr. E. W. Kellogg's place later in the spring, so spraying was done at both places on June 19 by State men.

East Hartford—1 Infestation—16 Egg-clusters

One colony of 16 egg-clusters was found in East Hartford this year in the southern end of the town in the margin of a swamp on land owned by H. C. Keeney. This colony was sprayed on June 15. All work in the town was done by State men.

East Windsor—4 Infestations—107 Egg-clusters

All four infestations found in East Windsor this year were in one group located near the center of the town. The largest was in white oak trees at Mr. C. S. Clapp's place, where 69 egg-clusters were found. Another of 22 egg-clusters was found in oaks and ironwood trees at Mr. R. H. Bartlett's. The next largest was a colony of 13 egg-clusters in a pasture white oak owned by Oliver Fenton. The fourth infestation was a colony of three egg-clusters in a white oak owned by F. N. Barber. The two largest colonies were sprayed on June 17 by State men.

Enfield—1 Infestation—2 Egg-clusters

Only one infestation was found in Enfield this year by the State crew that scouted the town. One old and one new egg-cluster were discovered on one oak and a maple tree owned by F. M. Davis, in Hazardville. No spraying was thought necessary.

Farmington—1 Infestation—9 Egg-clusters

The infestation in Farmington this year was a reinfestation of last year's colony in the northeastern corner of the town in woodland owned by Mr. Charles Beach. Three old and six new egg-clusters were found on oak, pine and spruce trees, and on June 12, a State crew sprayed about two and one-half acres of woodland in and around this colony.

Granby—8 Infestations—312 Egg-clusters

Eight infestations were found this year by State men in Granby, with a total of 312 egg-clusters. Of this total, 288 egg-clusters were found in three of the colonies. At the largest colony, 195 egg-clusters were found in woodland owned by Max Shinder, in the southwestern corner of the town. Another colony of 73 egg-clusters was found in one apple tree in the margin of a woodland owned by Edwin Dewey, one-half mile north of West Granby post office. The third was a colony of 20 egg-clusters in an apple tree owned by Francis Spring, near the Suffield town line in the northeastern corner of the town. Four places were sprayed by State men on June 20.

Hartford—9 Infestations—149 Egg-clusters

Although one more infestation was found in Hartford this year than in 1923, the total number of egg-clusters was greatly decreased; in fact 894 less egg-clusters were found this year than in 1923. The colony on the river flats just east of the Fuller Brush plant was again the largest infestation found in Hartford. Ninety-nine egg-clusters were found this year, where last year there were 936. Considering the difficulties met in handling this infestation, the results of last year's work are considered very satisfactory. Another colony of 22 egg-clusters was found on maple and poplar trees at No. 46 Vernon Street. The next largest was a colony of 10 egg-clusters found on elm and willow trees, on Flatbush Avenue. The six other infestations were all small, three of them being single egg-cluster infestations. Eight of the places were sprayed by State men about the middle of June.

Manchester

The scouting in Manchester this year was not completed, and only 12 miles of roadside covered, when the men had to be taken to fill vacancies in other crews, and before the work could be taken up again, the spraying season started. No gipsy moth infestation was found in the town as far as it was scouted.

New Britain—3 Infestations—15 Egg-clusters

Three small infestations were found in New Britain, the largest being at last year's colony on Bassett Street, opposite the High School. Nine egg-clusters were found on oak and pear trees here, where 110 were found last year. The other two infestations were on Washington Street, about one mile north of the colony just mentioned. One contained five egg-clusters on maple shade trees on city property, and the other was a single egg-cluster in an apple tree owned by John Cill. Two colonies were sprayed by State men on June 11.

South Windsor—3 Infestations—40 Egg-clusters

Three colonies were discovered this year in South Windsor by a State crew. One colony of 24 egg-clusters was on poplar, apple, locust and plum trees in the northwestern corner of the town. Another of 13 egg-clusters was found on a roadside apple tree owned by T. E. Sheppard, in the northern part of the town near the East Windsor line. The third contained three egg-clusters on three apple trees owned by Charles Parker, in the southeastern end of the town near the Manchester town line. All three places were sprayed on June 16 by State men.

Suffield—10 Infestations—784 Egg-clusters

Four of the 10 infestations found this year in Suffield were large ones although easily handled, as they were all on trees in open country. The largest was a colony of 371 egg-clusters in willow trees along the brook running parallel with the railroad just north of West Suffield village. Another colony of 143 egg-clusters was found a little further up the same brook on willow, white oak and walnut trees owned by Henry Barr. Another colony of 132 egg-clusters was found in one white oak on land owned by O. R. Austin, about three miles north of West Suffield village. The fourth largest colony was on oak trees in a pasture owned by Henry Sheldon, near the East Granby town line on the State road leading from West Suffield to East Granby, where 114 egg-clusters were found. Three infestations were sprayed in June by State men.

Simsbury—3 Infestations—72 Egg-clusters

Two of the infestations were found in the northwestern corner of the town, one of 32 egg-clusters and one of 11 egg-clusters, both in woodland owned by G. P. McLean and Mr. Furlong. The third colony was in apple trees owned by John Kilikoelski, in the extreme southern margin of the town, where 29 egg-clusters were found. Two of the colonies were sprayed in June by State men.

Wethersfield—2 Infestations—3 Egg-clusters

Both infestations were close together in the east end of the village near the Connecticut River, in the same locality where last year's big infestation of 622 egg-clusters occurred. Two egg-clusters were found at one place and one at the other. Both places were scouted for larvae on June 10, and as none were found, no spraying was thought necessary.

Windsor—2 Infestations—54 Egg-clusters

A State crew completed the scouting in Windsor on October 18. One colony of 46 egg-clusters in one white oak owned by Howard Throth, and another of eight egg-clusters on two roadside apple trees, were found. Both of the colonies were situated in about the center of the town, and were sprayed on June 18 by State men.

Four other towns in Hartford County were scouted by State crews, namely: Plainville, Rocky Hill, Southington and Windsor Locks, and no trace of the gipsy moth found in them.

MIDDLESEX COUNTY

Scouting was completed in the following six towns in Middlesex County this year by State crews: Clinton, Cromwell, Killingworth, Middlefield, Portland and Westbrook; nothing was found in any of them.

In Middletown, on account of the lateness of the season, scouting had to be confined to the sections around last year's infestations. Two egg-clusters were found at Mr. Johnson's place near Bear Hill; later larvae were found at this place, so spraying was done by State men on June 9.

NEW HAVEN COUNTY

Twenty towns were scouted this year in New Haven County by Federal and State crews; two towns were found infested, namely: Meriden and New Haven.

Meriden—1 Infestation—11 Egg-clusters

One colony of 11 egg-clusters was found in Meriden on poplar and maple trees on East Main Street, and on the property of St. Paul's Church, Curtis Memorial Library and Municipal building. The egg-clusters were scattered over the entire block and the infestation was sprayed on June 6 and 8 by State men.

New Haven—1 Infestation—120 Egg-clusters

A large colony of 120 egg-clusters was found in New Haven by Federal men in oak, elm and poplar trees owned by Mrs. R. Wood, at 603 Winchester Avenue. Spraying was done in a large area around the outside of this infestation in the early part of June by Federal men.

The following towns in New Haven County were scouted by State crews and nothing found: Cheshire, Wallingford, and Waterbury. Federal men scouted the towns of Ansonia, Beacon

Falls, Bethany, Derby, East Haven, Hamden, Middlebury, Milford, Naugatuck, Orange, Oxford, Prospect, Seymour, Southbury and Woodbridge, and found them free from gipsy moth infestation.

LITCHFIELD COUNTY

Barkhamsted—4 Infestations—131 Egg-clusters

Barkhamsted was scouted by State men and two large colonies were found in the southeastern end of the town; one of 70 egg-clusters was in woodland owned by Mrs. P. Perry; the other of 50 egg-clusters was in an orchard owned by John Lowander. Another smaller colony of nine egg-clusters was found in woodland owned by the Hartford Water Company, just east of Pleasant Valley. The fourth infestation was one of two egg-clusters found on two maples in a field owned by J. Legett, in the northeastern end of the town. All four of the infestations were sprayed in June by State men.

Canaan

Canaan was scouted by Federal men in the late spring. No egg-clusters were found, but at one 1923 infestation, larvae were found feeding, so 35 shade and 10 apple trees were sprayed in June.

Colebrook—4 Infestations—23 Egg-clusters

All four of the infestations found this year in Colebrook were small. They were in two groups of two infestations each. One group was in the extreme northeastern corner of the town, and both infestations were in woodland. The largest was a colony of five egg-clusters on land owned by Joe Tiller, and the other, one of four egg-clusters, was on land owned by Mr. Howell. The other group was in the western margin of the town; one colony of 12 egg-clusters was found on a maple tree and in a stonewall at Mr. McKenzie's place; the other was a colony of two egg-clusters in woodland owned by L. J. Phelps. Three places were sprayed June 24 by State men.

Cornwall—2 Infestations—23 Egg-clusters

Cornwall was scouted by Federal men, and two infestations were found. One of 19 egg-clusters was in woodland owned by J. Grusanski, in the southern end of the town about two miles east of Swift Bridge; the other was a colony of four egg-clusters on land owned by Constant Beauty, about one mile east of Cornwall Center. The larger colony was sprayed by Federal men.

New Milford—1 Infestation—3 Egg-clusters

Federal men in scouting New Milford this year, discovered three egg-clusters at last year's colony on Mr. F. L. Wanger's place, where 35 egg-clusters were found last year. It was sprayed in June by Federal men and it is hoped that the colony has been eradicated.

Norfolk—15 Infestations—286 Egg-clusters

All but one of the infestations found in Norfolk were situated in the northern half of the town. One small colony of five egg-clusters was found in woodland owned by Mrs. Spofford and the Norfolk Water Company in the southeastern corner of the town. Four of the colonies were large for this part of the State, but a large amount of spraying was done this year and it is hoped that most of the infestations have been cleaned up. The largest colony found was one of 83 egg-clusters in mixed woodland growth owned by E. H. Peasley, in the northeastern part of the town. The next largest contained 48 egg-clusters, in woodland and an orchard near the Massachusetts line in the northwestern corner of the town. A colony of 31 egg-clusters was found in willow and apple trees owned by Carl Stoeckel and Mr. Carlson, about one mile north of Norfolk post office. Another colony of 30 egg-clusters was discovered just north of the village of Norfolk in woodland owned by E. M. Shepard. These four colonies and 10 other smaller infestations were sprayed by Federal men.

North Canaan—2 Infestations—146 Egg-clusters

The work in North Canaan was all done by Federal men this year. Two infestations were found close together in the eastern end of the town near the Norfolk line, both in woodland. Four egg-clusters were found at Mr. Pescidar's place and 142 on the property of C. Rosier, and both places were sprayed.

The following towns in Litchfield County were scouted and nothing found: (by State men), Plymouth and Thomaston: (by Federal men), Bethlehem, Bridgewater, Kent, Morris, Roxbury, Salisbury, Sharon, Warren, Watertown, Washington and Woodbury.

FAIRFIELD COUNTY

Sixteen towns in Fairfield County were scouted by Federal crews this year, namely; Bethel, Brookfield, Bridgeport, Danbury, Easton, Fairfield, Monroe, Newtown, New Fairfield, Redding, Shelton, Sherman, Stratford, Trumbull, Weston and Westport. No gipsy moth infestations were found in the county.

The statistics of infestations, and work done in the towns covered, are given in the following tables:

STATISTICS OF INFESTATIONS, 1924-25

Towns	No. Infestations Found	No. Egg-Clusters Creosoted	No. Colonies Sprayed	No. Lbs. Poison Used	No. Larvae and Pupae Killed	No. Miles Roadway Scouted
Windham County:						
Brooklyn ...	27	903	16	781	16	47
Killingly* ...	43	1,676	21	277	462	116
Plainfield* ..	21	428	12	250	206	99
Pomfret	71	2,109	24	575	183	110
Putnam	68	1,956	42	629	980	84
Scotland	0	0	0	0	0	42
Sterling	2	82	2	25	3	56
Thompson* ..	103	5,256	22	964	1,094	131
Woodstock* .	41	3,902	13	450	11,741	94
	376	16,312	152	3,951	14,685	779
New London County:						
Colchester ..	5	394	4	925	64	134
Franklin	5	18	2	150	0	48
Griswold	3	54	2	16	18	37
Groton*	2	27	1	12	47	12
Lisbon†	0	0	0	0	0	285
Salem	0	0	0	0	0	54
Stonington*..	1	19	1	50	171	19
	16	512	10	1,153	300	489
Tolland County:						
Andover	1	30	1	12	0	41
Bolton	1	26	1	100	0	53
Columbia ...	2	175	2	150	48	54
Ellington ...	11	97	7	125	0	95
Hebron	1	12	1	25	0	68
Somers	16	81	6	118	0	82
Stafford	55	1,290	34	597	486	165
Vernon	2	47	1	81	0	81
	89	1,758	53	1,208	534	639
Hartford County:						
Avon	0	0	0	0	0	3
Berlin	0	0	0	0	0	88
Bloomfield ..	3	25	2	100	0	72
East Granby .	2	8	2	87	26	50
East Hartford	1	16	1	62	0	59
East Windsor	4	107	2	50	1	74
Enfield	1	2	0	0	0	87
Farmington..	1	9	1	200	39	89
Granby	8	312	4	100	98	90

* Work done by Federal scouts.
† Patrolled 1923 infestation.

Towns	No. Infestations Found	No. Egg-Clusters Creosoted	No. Colonies Sprayed	No. Lbs. Poison Used	No. Larvae and Pupae Killed	No. Miles Roadway Scouted
Hartford County—*cont.*:						
Hartford	9	149	8	1,037	8	128
Manchester	0	0	0	0	0	12
New Britain	3	15	2	425	221	58
Plainville	0	0	0	0	0	30
Rocky Hill	0	0	0	0	0	44
Simsbury	3	72	2	87	2	94
Southington	0	0	0	0	0	73
South Windsor	3	40	3	75	8	79
Suffield	10	784	3	131	3,450	88
Wethersfield	2	3	0	0	0	53
Windsor Locks	0	0	0	0	0	26
Windsor	2	54	2	37	0	70
	52	1,596	32	2,391	3,853	1,367
Middlesex County:						
Clinton	0	0	0	0	0	37
Cromwell	0	0	0	0	0	52
Killingworth	0	0	0	0	0	62
Middlefield	0	0	0	0	0	33
Middletown*	0	0	1	62	1	..
Portland	0	0	0	0	0	78
Westbrook	0	0	0	0	0	29
	0	0	1	62	1	291
New Haven County:						
Ansonia*	0	0	0	0	0	52
Beacon Falls*	0	0	0	0	0	21
Bethany*	0	0	0	0	0	62
Cheshire	0	0	0	0	0	43
Derby*	0	0	0	0	0	35
East Haven*	0	0	0	0	0	40
Hamden*	0	0	0	0	0	115
Meriden	1	11	1	290	225	147
Middlebury*	0	0	0	0	0	60
Milford*	0	0	0	0	0	85
Naugatuck*	0	0	0	0	0	73
New Haven*	1	120	1	125	0	90
Orange*	0	0	0	0	0	111
Oxford*	0	0	0	0	0	80
Prospect*	0	0	0	0	0	43
Seymour*	0	0	0	0	0	50
Southbury*	0	0	0	0	0	120
Wallingford	0	0	0	0	0	134
Waterbury	0	0	0	0	0	147
Woodbridge*	0	0	0	0	0	55
	2	131	2	415	225	1,563

* Scouted only around old infestation.

Towns	No. Infestations Found	No. Egg-Clusters Creosoted	No. Colonies Sprayed	No. Lbs. Poison Used	No. Larvae and Pupae Killed	No. Miles Roadway Scouted
Litchfield County:						
Barkhamsted.	4	131	4	268	22	97
Bethlehem* .	0	0	0	0	0	53
Bridgewater*.	0	0	0	0	0	50
Canaan*	0	0	1	150	0	60
Colebrook ..	4	23	3	150	2	77
Cornwall* ..	2	23	1	150	0	104
Kent*	0	0	0	0	0	90
Morris*	0	0	0	0	0	50
New Milford*	1	3	1	187	0	177
Norfolk* ...	15	286	14	5,244	0	93
North Canaan*	2	146	2	412	0	56
Plymouth ...	0	0	0	0	0	98
Roxbury* ...	0	0	0	0	0	74
Salisbury* ..	0	0	0	0	0	112
Sharon*	0	0	0	0	0	144
Thomaston ..	0	0	0	0	0	56
Warren*	0	0	0	0	0	64
Washington*.	0	0	0	0	0	111
Watertown* .	0	0	0	0	0	90
Woodbury* ..	0	0	0	0	0	100
	28	612	26	6,561	24	1,756
Fairfield County:						
Bethel*	0	0	0	0	0	49
Bridgeport*..	0	0	0	0	0	117
Brookfield* ..	0	0	0	0	0	68
Danbury* ...	0	0	0	0	0	164
Easton*	0	0	0	0	0	81
Fairfield*	0	0	0	0	0	128
Monroe*	0	0	0	0	0	75
New Fairfield*	0	0	0	0	0	52
Newtown* ..	0	0	0	0	0	180
Redding* ...	0	0	0	0	0	96
Shelton*	0	0	0	0	0	89
Sherman* ...	0	0	0	0	0	49
Stratford* ..	0	0	0	0	0	58
Trumbull* ..	0	0	0	0	0	66
Weston*	0	0	0	0	0	53
Westport* ..	0	0	0	0	0	90
	0	0	0	0	0	1,415

SUMMARY OF STATISTICS

County	No. Towns Covered	No. Infestations Found	No. Egg-Clusters Creosoted	No. Colonies Sprayed	No. Lbs. Poison Used	No. Larvae and Pupae Killed	No. Miles Roadway Scouted
Windham	9	376	16,312	152	3,951	14,685	779
New London	7	16	512	10	1,153	300	589
Tolland	8	89	1,758	53	1,208	534	639
Hartford	21	52	1,596	32	2,391	3,853	1,367
Middlesex	7	0	0	1	62	1	291
New Haven	20	2	131	2	415	225	1,563
Litchfield	20	28	612	26	6,561	24	1,756
Fairfield	16	0	0	0	0	0	1,415
	108	563	20,921	276	15,741	19,622	8,399

Quarantine

The Federal forces again scouted the towns of Cheshire and Wallingford, and as no gipsy moth infestations were found, these towns have been released from the Federal quarantine.

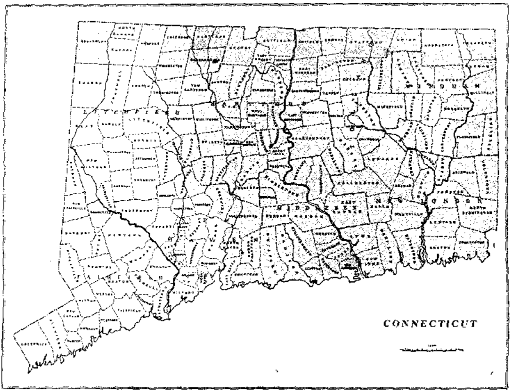


Fig. 41.—Map of Connecticut. The shaded portion represents the area quarantined on account of the gipsy moth. Late in the season the towns of Cheshire and Wallingford were released from quarantine, but are not so designated on this map.

Parasites

Each year for several years, parasites reared at the Federal Parasite Laboratory, Melrose Highlands, Mass., have been liberated in Connecticut. The names of the species and the names of the towns where liberated, together with the number of individuals liberated in each town, have been published in preceding reports. In 1925, only one species, an egg parasite, *Anastatus bifasciatus* Fonsc., was liberated in Connecticut, and colonies were planted in 40 towns in six counties by Mr. McEvoy. The following list gives the names of the towns where these parasites were liberated in 1925, and the number liberated in each town:

Gipsy Moth Parasites Liberated in Connecticut

Year Ending June 30, 1925

County	Town	Anastatus bifasciatus	
New London	Bozrah	3,000	
	Colchester	13,000	
	East Lyme	10,000	
	Franklin	11,000	
	Groton	14,000	
	Lisbon	5,000	
	Montville	6,000	
	Old Lyme	5,000	
	Preston	58,000	
	Salem	1,000	
	Sprague	2,000	
	Waterford	2,000	130,000
Hartford	Berlin	15,000	
	Bloomfield	3,000	
	East Granby	5,000	
	East Hartford	8,000	
	East Windsor	5,000	
	Enfield	1,000	
	Farmington	3,000	
	Glastonbury	8,000	
	Granby	17,000	
	Hartford	17,000	
	Hartland	7,000	
	Manchester	6,000	
	New Britain	7,000	
	Newington	7,000	
	Simsbury	8,000	
	South Windsor	1,000	
	Suffield	8,000	
	West Hartford	3,000	
	Wethersfield	1,000	
	Windsor	4,000	134,000
Tolland	Andover	3,000	
	Bolton	6,000	
	Hebron	3,000	
	Vernon	2,000	14,000
Litchfield	Barkhamsted	7,000	
	Colebrook	6,000	13,000
New Haven	Meriden	2,000	2,000
Middlesex	Middletown	8,000	8,000
			301,000

Gipsy Moth Suppression Account

FINANCIAL STATEMENT

Receipts

Appropriation for biennial period ending June 30, 1925	$100,000.00
Expended, year ending June 30, 1924	41,798.01
Balance	$58,201.99

Classified Expenditures for the Year Ending June 30, 1925

Salaries and Wages		$42,934.99	
Printing and Illustrations		73.88	
Postage		.65	
Stationery		53.28	
Telegraph and Telephone		34.87	
Insurance		170.90	
Spraying Supplies		1,300.00	
Machinery, Tools and Supplies		1,467.81	
Express, Freight and Cartage		6.74	
Rental and Storage		818.68	
Automobiles: New	$3,715.00		
Insurance	482.49		
Repairs	1,636.87		
Supplies and Equipment	1,619.96		
Gasoline	2,139.56		
Oil	712.51		
		10,306.39	
Traveling Expenses		467.18	
Inspection of Imported Nursery Stock		169.39	
Heat and Light		173.64	
Miscellaneous		.85	
			$57,979.25
Balance			222.74
			$58,201.99

FURTHER EXPERIMENTS IN DUSTING AND SPRAYING APPLE ORCHARDS

Season of 1925

By M. P. Zappe and E. M. Stoddard

The experimental work with dusts and liquid sprays begun in 1920 was continued in 1925, the chief object being to make further tests of combined dust and spray treatments. Consequently the plots receiving only dust and others receiving only spray were continued for purposes of comparison, and in addition several combinations of spray and dust were tested.

The results of former tests made at this Station have been published in the Station bulletins and reports as follows: Report for 1920, page 168, results of 1920; Bulletin 235, results of 1921; Bulletin 245, results of 1922; Report for 1923, page 267, results for 1923; Report for 1924, page 286, results of 1924.

Orchard Under Experiment

The orchard of Mr. Frank N. Platt, Milford, which has been employed in preceding tests, was also used in 1925. It contains about 285 trees, 21 years old. The varieties selected for the test in 1925 were Baldwin, Greening and McIntosh.

Acknowledgments

The writers are indebted to Mr. Frank N. Platt for the use of his orchard, power sprayer, and assistance in conducting the tests, and to Messrs. B. H. Walden, Philip Garman and J. L. Rogers, who assisted in scoring the fruit at harvest time.

Method of Recording Data

Trees which blossomed freely were selected as count trees. The ripe fruit was harvested and left in baskets under the tree from which it was picked and each apple scored for insect and fungous injury. All injuries on each fruit were recorded even though slight, and often several kinds of injury were noted on a single apple; in such cases all types of injury were recorded separately. Later these figures were tabulated and percentages obtained. Altogether, this work necessitated the separate handling and scoring of 136,486 individual apples, equivalent to about 341 barrels.

In scoring fruit, we use a sorting table at which four men can work conveniently. Each apple is examined and the injury recorded on a score board; if the apple is perfect this fact is recorded. The score board consists of a series of tallying registers which are mounted on a board for convenience, as shown on Plate V, b. In front of each register is the name of the injury to be recorded on that particular register. The men doing the scoring of the fruit call off the injury to another man who does nothing but record the data as it is given, or the board may be placed on the sorting table and each man who scores can record his own data. On check trees where injuries are numerous and of various kinds, they are recorded singly for each fruit. Where injuries are mainly of one or two kinds, they are often recorded in lots of five. In this case a scorer holds the type of injury, or good apples as the case may be, in one hand until he has five, and then records it by pressing the lever of the register once, it being understood that each figure on that register represents five apples or five injuries.

Often several kinds of injury are found on one apple; in this case each type of injury is recorded and the register marked "Duplicate" must be punched once for each injury except the first one. When the results are tabulated, the number on the

"Duplicate" register subtracted from the total number of injuries will give the total number of apples scored. This figure must be known when the percentages are worked out.

After all the fruit from a certain tree has been scored, the figures on the tallying registers are recorded on score sheets which are carried in a shallow drawer under the score board, and are fastened to the top of the board by thumb tacks when in use, (see Plate V, b).

The number of registers needed on the score board depend upon the kind of fruit to be scored. When scoring apples, from eight to ten registers are needed, and for peaches, five or six are sufficient. Oftentimes some of the registers may be used to indicate the degree of injury: whether light, medium or heavy. In scoring apples for curculio injury, the number of scars can be easily recorded by the use of these registers.

Materials and Apparatus Used

The 90-10 sulphur dust which former tests have shown to be the best adapted for Connecticut conditions was the only dust used in 1925. This contains 90 parts of sulphur and 10 parts of lead arsenate, by weight.

Materials used in the liquid spray were as follows:

Dry lime-sulphur	6 pounds
Lead Arsenate	3 pounds
Casein spreader*	1 pound
Water	100 gallons

The spray outfit was the same as used in the preceding experiments, a 200 gallon Friend power sprayer carrying two lines of hose with rods and nozzles. The duster was a 1923 model Niagara power outfit, mounted on an automobile truck.

Arrangement of Plots in the Platt Orchard

This orchard was divided into six plots of two rows each, with the varieties running across the rows, so that all varieties were represented in each plot. Rows A and B were sprayed throughout the season; rows C and D were dusted with 90-10 dust the entire season; rows E and F were sprayed at the prepink, pink and calyx treatments, and were dusted three times afterwards; rows F and H were sprayed at prepink and third treatment after calyx, and dusted at pink, calyx, first and second treatments afterwards; rows I and J were dusted at the prepink, calyx and second treatment after calyx, and sprayed at the pink and first and third treatments after calyx; row M was a check row and received no treatment.

* Used only on a portion of one plot.

Application	Date	Rows A & B	Rows C & D	Rows E & F	Rows G & H	Rows I & J	Row M	Varieties Treated
No. 1 Prepink	Apr. 27	Spray	Dust	Spray	Spray	Dust	Check	McIntosh only
No. 2 Pink	May 1	Spray	Dust	Spray	Dust	Spray	Check	All varieties
No. 3 Calyx	May 15	Spray	Dust	Spray	Dust	Dust	Check	All varieties
No. 4, 1st after calyx	June 3	Spray	Dust	Dust	Dust	Spray	Check	All varieties
No. 5, 2d after calyx	July 1	Spray	Dust	Dust	Dust	Dust	Check	All varieties
No. 6, 3d after calyx	July 27	Spray	Dust	Dust	Spray	Spray	Check	All varieties

The sprayed plot was divided into two sections, one with and the other without casein spreader.

The numbers designating the applications may be explained as follows; 1, prepink; 2, pink; 3, calyx; 4, first treatment after calyx; 5, second treatment after calyx; 6, third treatment after calyx.

Results of Treatment on McIntosh

	Spray No Casein	Spray Casein	Dust	Spray 1, 2, 3 Dust 4, 5, 6	Spray 1 and 6 Dust 2, 3, 4, 5	Spray 2, 4, 6 Dust 1, 3, 5	Check
Good	86.5	90.5	88.8	89.5	80.9	79.	.86
Scab	6.4	2.7	2.08	1.2	6.35	7.7	51.7
Aphis	1.76	3.5	3.21	3.20	4.38	5.56	4.79
Red bug	.86	.8	.34	.81	.63	.35	2.25
Codling moth	.01	.04	.27	.16	.15	.01	4.29
Curculio	3.42	2.1	4.57	3.92	5.18	6.12	29.6
Other chewing insects	1.45	.5	1.37	1.33	2.52	1.2	6.48

Discussion of Results

There are no striking results from any one treatment shown in this table, there being only small differences in the percentages of good fruit from the various treatments. The difference between the highest and lowest percentage of good fruit is only about 11 per cent. In the sprayed plot, there was a very slight advantage in the section which had casein spreader in the mixture. The percentage of scab in the treated plots was not high in any case, but in the check plot over one-half of the fruit showed traces of

the disease. The plot receiving only dust treatments had less scab than the dust plots of former years. In the combined spray and dust plots, the one having the early sprays and dust later in the season gave a somewhat higher percentage of good fruit, and a little lower percentage of scabby fruit, than the others.

Results of Treatment on Baldwin

	Spray No Casein	Dust	Spray 1, 2 Dust 3, 4, 5	Spray 5 Dust 1, 2, 3, 4	Spray 1, 3, 5 Dust 2, 4	Check
Good	91.27	83.6	87.97	85.25	86.9	1.79
Aphis	.94	1.13	3.93	1.75	3.89	.78
Red bug	1.76	.90	1.44	2.35	.99	2.66
Codling moth	.52	1.67	.74	.36	.23	2.01
Curculio	5.90	9.50	4.27	8.63	5.39	39.3
Other chewing insects	1.66	3.85	2.53	2.13	2.8	19.9
Sooty blotch	0	0	0	0	0	36.2
Fruit speck	0	0	0	0	0	68.6

Discussion of Results

This variety bore no fruit in the casein spray plot; therefore no figures can be shown. In general the sprayed plot gave a little the highest percentage of good fruit, though the differences are slight. The dusted plot yielded a somewhat lower percentage of perfect fruit and slightly higher percentage of codling moth, curculio and other chewing insect injury, but not enough higher to make any great difference. The combined spray and dust plots were nearly as good as the sprayed plot; in fact there were no very great differences between any of the plots. There was no scab and hardly a trace of sooty blotch and fruit speck on the fruit from any of the treated plots.

Results of Treatments on Greening

	Spray No Casein	Spray Casein	Dust	Spray 1, 2 Dust 3, 4, 5	Spray 5 Dust 1, 2, 3, 4	Spray 1, 3, 5 Dust 2, 4, 6	Check
Good	86.15	92.05	91.1	92.7	91.05	89.5	1.2
Aphis	1.91	2.86	1.50	.68	1.74	2.06	1.29
Red bug	1.13	1.08	.68	.51	.47	.65	4.75
Codling moth	.41	.35	.23	.23	.50	.64	7.74
Curculio	7.89	3.06	4.21	3.91	4.48	5.65	78.0
Other chewing insects	1.99	.84	2.52	1.96	2.01	1.39	21.6
Scab	.96	.04	.05	.25	.21	.23	21.2
Sooty blotch	0	0	0	0	0	0	70.5
Fruit speck	0	0	0	0	0	0	25.0

Discussion of Results

The results on Greening were similar to those obtained on Baldwin, there being no particular plot which was very much better or worse than any of the others. The combination plot receiving early sprays and late dusts gave a slightly higher percentage of good fruit than any others. The spray plot with casein was a little better than that which had no casein in the mixture. The amount of scab on all plots was negligible except in the check, where it ran up to 21 per cent. The check plot also showed 70 per cent. of sooty blotch and 25 per cent. of fruit speck, while the treated plots had none.

Summary and Conclusions

In an attempt to find some way to determine the relative value of different spray treatments, we have devised a method of scoring which seems to give accurately and briefly the desired result. This method consists of listing the treatments and injuries as shown in the table below and checking for each treatment the troubles it controlled the best in comparison with other treatments in the same experiment, and checking for highest percentages of good apples. For example, in the accompanying table, we find from our data that treatment No. 1 best controlled codling moth on McIntosh, and we indicate this under No. 1, opposite codling moth, by a letter M. If two treatments are equally good, each one is checked. The sum of the scores under each treatment give the relative value of each.

	1 Spray No Spreader	2 Spray with Spreader	3 Dust	4 Spray 1, 2, 3 Dust 4, 5, 6	5 Spray 1, 6 Dust 2, 3, 4, 5	6 Spray 2, 4, 6 Dust 1, 3, 5
Good	B	M		G		
Aphis	BM			G		
Red bug			BM		G	
Codling moth	M		G	G		MB
Curculio		GM		B		
Other chewing insects	B	GM				
Scab	B	GB	B	MB	B	B
Sooty Blotch	BGM	BGM	BGM	BGM	BGM	BGM
Fruit Speck	BGM	BGM	BGM	BGM	BGM	BGM
Total score	12	13	10	12	8	9

B = Baldwin G = Greening M = McIntosh

From this table we find that spray with spreader was the most efficient and spray without spreader and combination No. 4 tied for second place, followed by dust and combinations No. 6 and No. 5, in the order named.

Our results are well summarized in the above table as regards effectiveness of treatments, and a few other features not shown in the table will be mentioned briefly in conclusion. Scab was less prevalent than usual in 1925, due to weather conditions unfavorable for infection in the spring, all control measures gave good results and such infection as did occur was light to medium even on untreated trees. Rains and high humidity in early May undoubtedly would have caused a wider difference in favor of spraying. The same is also true of sooty blotch and fruit speck, as a subnormal rainfall in July and August made conditions unfavorable for infection, especially of fruit speck. No nicotine solution was used in the summer applications, but evidently there was some control value in all the treatments especially spraying at the prepink, pink and calyx.

As our work was conducted to collect data on combinations of spray and dust, we would call attention to the combination with the first three applications of spray and the last three of dust which gave results comparable with spray in all six applications. If this gives effective control in a normal scab year and coupled with entire freedom from the chance to burn the foliage in midsummer, this combination ought to prove satisfactory.

EFFICIENCY OF DELAYED DORMANT APPLICATIONS FOR THE CONTROL OF APPLE APHIDS

By M. P. Zappe and E. M. Stoddard

It is a fact well known among fruit growers that at the time that the delayed dormant sprays are applied, most of the apple aphids have hatched.

It should be understood that the following three species of aphids infest the apple, and their eggs hatch in the order given: (1) spring grain aphid, *Toxoptera graminum* Rondani; (2) green apple aphid, *Aphis pomi* DeGeer; (3) rosy apple aphid, *Anuraphis roseus* Baker. All species are sometimes present on the buds, but the green apple aphid is the commonest species and the spring grain aphid, which is not injurious to the apple, was not abundant in Connecticut apple orchards in 1925. As the rosy aphid, the most injurious species, does not hatch until rather late, usually when the tips of the leaves are perhaps half an inch long, it is important that the treatment be delayed until late enough to kill the young rosy aphids after the eggs have hatched. These aphids may be found clustered on the tops of the swelling buds

and occasionally some may be seen crawling along the twigs from one bud to another. At this time they are unprotected by any foliage and an application of the proper spray, thoroughly applied, will give more satisfactory control than later sprays, especially after the aphids have begun to curl the leaves around themselves.

In order to compare some of the ordinary dormant sprays for aphid control, we sprayed the orchard of Mr. Frank N. Platt at Milford. Four varieties of apples were used in the tests: McIntosh, Baldwin, Greening and Gravenstein. The orchard was divided into four plots which were treated as follows:

Plot	I	Dry lime-sulphur, 12 lbs. to 100 gals. water
Plot	II	Dry lime-sulphur, 12 lbs. to 100 gals. water, and 1 pint nicotine
Plot	III	Sunoco spray oil, 1 part to 20 parts water
Plot	IV	Check (no treatment)

The spray applications were made on April 14 and 15, using a Friend 200-gallon power sprayer. Two lines of hose with rods and two nozzles at each rod were used. At this time the buds were just beginning to show the green tips of the young unfolding leaves, and aphids that had hatched were clustered on the tops of the buds.

A little later in the season, on May 8, after the aphids had begun to reproduce, several trees in each plot were selected at random and 100 twigs per tree were scored for aphids. The terminal leaves on the selected twigs were examined and were classified as having no aphids, light, medium or heavy infestation.

The following tables show the number of terminal twigs examined and the results:

DRY LIME-SULPHUR AND NICOTINE

Variety	Light	Medium	Heavy	None	Total Infestation Per Cent
Greening	44	10	6	40	60
Baldwin	40	10	0	50	50
Gravenstein	44	12	8	36	64
McIntosh	44	14	10	32	68
Average for all varieties	43	11.5	6	39.5	60.5

DRY LIME-SULPHUR, NO NICOTINE

Variety*	Light	Medium	Heavy	None	Total Infestation Per Cent
Greening	60	14	6	20	80
Baldwin	62	16	8	14	86
McIntosh	72	8	6	14	86
Average for all varieties	64.6	12.6	6.6	15.3	84

* No Gravenstein trees in this plot.

Sunoco Spray Oil

Variety	Light	Medium	Heavy	None	Total Infestation Per Cent
Greening	26	4	0	70	30
Baldwin	48	0	2	50	50
Gravenstein	66	12	4	18	82
McIntosh	42	4	2	52	48
Average for all varieties	45.5	5	2	47.5	52.5

Check

Variety	Light	Medium	Heavy	None	Total Infestation Per Cent
Greening	62	28	4	6	94
Baldwin	60	20	10	10	90
Gravenstein	40	36	16	8	92
McIntosh	56	12	8	24	70
Average for all varieties	54.5	24	9.5	12	88

Summary

It may be seen from the foregoing tables that Sunoco spray oil at the strength of one part oil to 20 parts water was the most efficient of the sprays used for the control of aphids at the delayed dormant period. Lime-sulphur and nicotine was second best. Lime-sulphur without the nicotine was only a little better than the check trees.

The Gravenstein variety seems to be very susceptible to aphid attacks, while the McIntosh seems to be more immune. This is not only true of aphid infestations of leaves, but in former experiments has often been found to hold true of aphid injured fruit, the Gravenstein apples showing great distortion by this insect, while the McIntosh fruit shows very little.

It therefore seems very important that greater efforts be made to control aphids on Gravenstein than on McIntosh.

If the fruit grower contemplates using nicotine in his sprays, we feel that it is best to use it in the delayed dormant, prepink and pink sprays, or even in the calyx spray, if aphids are plentiful enough at this time to warrant the expense. In later sprays than these, it is of doubtful value; in fact it is almost useless to try to control aphids after the trees are in full leaf.

THE ORIENTAL PEACH MOTH IN 1925

Philip Garman

The Oriental peach moth continued to do damage in Connecticut in 1925 and increased considerably in severity in the Wall-

ingford section. In the course of experimental work, wormy fruit was found amounting to 46 per cent. in one orchard. Though not nearly as severe in other orchards, yet the damage was enough to be noticed and commented upon. In some orchards no increase was noticed over last year.

Spraying operations were conducted in two different orchards and life history work was carried on at the Station, supplemented by many field observations. The first adult emerged from hibernation May 5, and adults continued to emerge until June 11. Eggs of the first generation were deposited beginning May 15, continuing until June 17. The first brood (from egg to adult) extended in 1925 from May 15 until July 19. Second brood eggs were laid, beginning June 27 continuing until July 22, the brood extending from June 27 until August 20. The third brood eggs were laid, beginning July 28 and continuing until August 27. Many of the larvae of this generation hibernated but some emerged, producing a fourth or partial fourth generation. According to our records this partial fourth generation began September 6, the first egg being obtained on that day. Whether many of this brood actually reach maturity and hibernate has not been determined for Connecticut. The last adult emerged September 20, and adults were trapped in the orchards September 21. All data obtained is illustrated graphically in Figure 42, the stippled areas indicating the probable extent of the stage in cases where insectary data is apparently incomplete. About 1,500 eggs in all were obtained from moths in captivity and over 500 individual cages were handled in obtaining the records.

Several parasites have been reared from the insect, as follows:

Eubadizon sp. A parasite overwintering in the cocoon of the host and emerging in spring about the time the moths appear. Adults were obtained May 7 and 8, and August 14. The host material was collected in Wallingford and Greenwich, Connecticut.

Macrocentrus ancylivora Rohwer. A fairly abundant parasite in August emerging July 28 and August 28 from our specimens. This parasite is apparently identical with important parasites found in New Jersey, Maryland and Virginia. It was obtained from host material collected in Wallingford.

Glypta rufiscutellaris (Walsh). Two specimens obtained in Wallingford emerged from the host July 28, 1925.

The control experiments were conducted in the orchard of the Barnes Nursery and Orchard Company at Wallingford through the courtesy of the Messrs. Barnes; and at the Conyers farm orchard at Greenwich through the courtesy of Mr. G. A. Drew. Treatments in both cases were supplementary to the regular treatments given, which in both cases comprised treatments for control of scab and curculio, and in the Conyers farm orchard, a fall

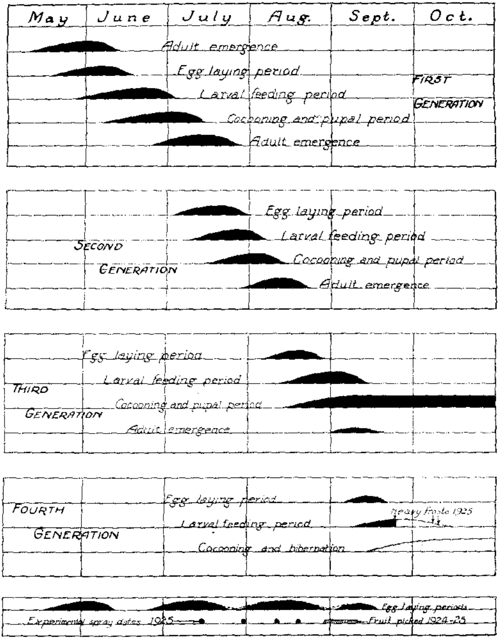


FIG. 42.—Oriental Peach Moth. Preliminary life history chart based on data obtained in 1925. This chart is not intended to give complete results since there are many points which need further study. However, it shows the trend of development in 1925 as correlated with out spray program. The stippled areas are uncertain periods which are indicated by field observation. There is also a possibility that some of the second generation larvae pass the winter, but of this we have not yet secured any evidence for Connecticut. The adult emergence as shown under the head of "first generation" is in reality a part of the third and fourth generations of the previous season. It is shown in this position on the chart for the sake of convenience.

application of lime-sulphur. It will be seen that none of the treatments, or those of last year as shown in Table I, reduced the amount of infested fruit below 10 per cent., and we have been forced to conclude that other measures must be found and that all known means of control must be employed in a severe infestation in order to bring through a larger amount of sound fruit. Consequently tests were made of a number of different insecticides with a view to determining what substances if any would kill the larva before entering or would provide a suitable coating upon which the larva would feed without digging into the peach or twig. Results of these tests are not yet complete. Small bait pans were also employed in the field to determine the possibility of capturing moths by this means, thus reducing the total population of the insect in the orchard. In six small tin buckets hung in a bearing orchard, 283 moths were captured between August 11 and September 1. Honey, water and yeast was first employed, but was later replaced by molasses and water according to the recommendations of Peterson.[1] Adults fly into the mixture, their wings become wet and they are unable to escape. This means of control shows some promise and several investigators are busy working out details of application. It is hoped that it will provide the necessary means of increasing sound fruit and will prove sufficiently economical. The whole problem of control is very difficult owing to the habits of the insect, which seems to have developed almost a perfect defense, and about the best that can be done at the present time is the recommendation of nicotine sprays; cultivation before May 5, so as to bury the larvae to a depth of three inches; treatment with paradichlorobenzene to destroy the larvae hibernating on the trunk near the ground and destruction or removal of drop fruits. Our experiments to date indicate that four sprays containing nicotine sulphate as applied in 1925 gave as good control as five sprays applied in 1924, though at somewhat different intervals. In 1925 these sprays were applied July 13, August 10 and August 20, the fruit being picked the first of September. In 1924, the fruit was picked nearly two weeks later and the final treatments were given August 15. Life history data obtained in Connecticut thus far show that the insect was very abundant in August during 1924 and 1925, and this probably accounts for the favorable results obtained from the treatments in 1925. Considerable foliage injury was noted in the blocks sprayed with nicotine and fish oil soap (potash) which was attributed to an increase of soap in one application (four pounds to 50 gallons of water), since subsequent sprays containing two pounds of soap per 50 gallons did no damage. Sulphur arsenate dusts (acid lead arsenate 10 per cent., sulphur 90 per cent.) caused some of the leaves to turn yellow and drop, although applied

[1] Peterson, A. Journal of Economic Entomology, Vol. 18, 181-190, 1925.

carefully when most of the foliage was dry. This dust in itself is not effective enough and too dangerous to be considered for treatments to control the Oriental peach moth. Nicotine dust caused no noticeable damage, but it is evident that is cannot be used as late as the nicotine soap spray since it has a tendency to cling in the fur of the peach if applied less than three weeks before picking time. This would undoubtedly affect the sale of the fruit. On the other hand, nicotine soap sprays may be applied as late as needed without leaving any undesirable residue on the peaches at harvest time. The nicotine sulphate can probably be added to a fungicide such as self-boiled lime-sulphur or dry mix sulphur lime without decreasing its effectiveness. Very late applications should contain only nicotine sulphate or nicotine sulphate and soap.

TREATMENTS FOR ORIENTAL PEACH MOTH CONTROL, 1924-1925

TABLE I.

Treatment	Farm and Date	No. of Peaches Considered	Total per cent. injured
1. Self-boiled lime-sulphur, June 9 and July 14	Conyers Farm 1924	2,186	23.
2. Nicotine sulphate, self-boiled lime-sulphur, casein lime; July 9 and July 14; nicotine sulphate plus soap, June 30, July 28 and August 15	Conyers Farm 1924	2,167	14.
3. Sulphur arsenate dust followed by nicotine dust, June 9 and July 14; nicotine dust, June 30, July 15 and August 2	Conyers Farm 1924	1,692	11.
4. Nicotine dust, July 13, July 29 and August 10	Conyers Farm 1925	1,964	23.
5. 90-10 sulphur arsenate dust, July 13 and August 10	Conyers Farm 1925	1,932	15.5
6. Nicotine-soap spray, July 13, July 29, August 10 and August 20	Conyers Farm 1925	1,883	10.5
7. Check	Conyers Farm 1925	1,924	21.5
8. 90-10 dust, July 15 and August 14	Barnes Orchard 1925	824	38.
9. Nicotine dust, July 15, July 30 and August 14	Barnes Orchard 1925	755	28.
10. Check	Barnes Orchard 1925	439	46.

CONTROL OF ORIENTAL PEACH MOTH

TABLE II. BARNES ORCHARD—1925

Treatment Received	Total No. Peaches	No. Good	% Good	New Injury: Side	New Injury: Stem	New Injury: % Side	New Injury: % Stem	New Injury: % New Injury	Old Injury: Side	Old Injury: Stem	Old Injury: % Side	Old Injury: % Stem	Old Injury: % Old Injury	Total Injuries	Total % Injured
90-10 Dust, July 15, August 14	824	511	62.01	22	213	2.66	25.84	28.51	40	46	4.85	5.58	10.43	313	37.98
Nicotine dust, July 15, July 30, August 14	755	544	72.05	15	158	1.98	20.92	22.91	20	18	2.64	2.39	5.03	211	27.94
Check	439	234	53.30	19	129	4.32	29.38	33.71	23	34	5.23	7.74	12.98	205	46.69

TABLE III. CONYERS FARM ORCHARD—1925

Treatment Received	Block No.	Total No. Peaches	No. Good	% Good	New Injury: Side	New Injury: Stem	New Injury: % Side	New Injury: % Stem	New Injury: % New Injury	Old Injury: Side	Old Injury: Stem	Old Injury: % Side	Old Injury: % Stem	Old Injury: % Old Injury	Total Injuries	Total % Injured
Nicotine dust (2.7%), July 13, July 29, August 10	1	1,964	1,514	77.08	1,191	220	6.05	11.206	17.26	66	31	3.36	1.57	4.93	450	22.91
90-10 Sulphur-arsenate dust, July 13, August 10	2	1,932	1,631	84.42	41	215	2.12	11.12	13.25	37	9	1.91	.46	2.38	301	15.57
Check	3	1,924	1,509	78.43	79	266	4.10	13.82	17.93	39	21	2.02	1.09	3.11	415	21.56
Nicotine spray (1 qt.-200 gals.) plus fish oil soap, July 13, July 29, August 10 and August 20	4	1,883	1,685	89.48	37	117	1.96	6.21	8.11	32	7	1.69	.37	2.07	198	10.51

Explanation of Tables II and III

All fruit from these blocks was taken from trees in the center of the block. At Conyers Farm, two baskets were taken from each of 10 selected trees, of approximately equal bearing capacity—the peaches being picked from all parts of the tree and subsequently cut open to determine whether infested or not. There were approximately 60 trees in each block, the trees being of considerable size, as shown in Plate VI. Prevailing winds blew across the blocks from end to end and not from one block to another. The nicotine dust block, however, was alongside of an apple orchard which may in part account for the poor showing made by this method of treatment. Owing to the possibility of allowing dusts to remain on the fruit at picking, it was found necessary to reduce the number of applications as compared with sprays containing nicotine. Only three applications of dust were made as against four sprays. The variety was Belle of Georgia.

The work at Barnes orchard, Table II, was carried out in a similar manner, but the amount of fruit scored was much smaller and the results obtained are not considered to be of as much value as those obtained at Conyers Farm. Prevailing winds in this orchard blew across the three different blocks from the sulphur-arsenate dust plot to the nicotine dust to the check which was at the far side of the orchard. The variety was Elberta.

In both tables, the heading "new injury" is intended to show that made by late entering larvae probably the third brood, and in most cases the larva itself was found. The heading "old injury" refers to old scars usually accompanied by considerable gum indicating that it was caused by the feeding of the first or second brood larvae. In this case the larva was never found within the peach.

THE CURCULIO PROBLEM IN CONNECTICUT

Philip Garman

The plum curculio in Connecticut offers a serious hindrance to the production of perfect apples in many orchards. It is not so much a problem in peach orchards, although it occurs there abundantly, but apparently there is no second brood of larvae and peaches rarely become extensively infested. Certain varieties of plums are naturally attacked, this fruit being a favorite food, but since plums are not grown extensively in Connecticut, the problem of control is not pressing. It is also known to feed upon cherries, apricots and nectarines. On the other hand, a large proportion (often 80 or 90 per cent.) of the apples in a commercial orchard may be deformed or destroyed and a considerable percentage of marred fruit may and often does remain after

thorough spraying. Such conditions to be remedied need the most careful study of the curculio's habits as well as thorough and painstaking application of control methods.

The curculio is one of the oldest pests of apples and other fruits in Connecticut. Mention of it is found in almost all literature dealing with fruit culture dating back as far as colonial times—and strange to say, some of the oldest methods of fighting the insect are often practiced to-day. Arsenical sprays have been mainly developed during the past 60 years and there will no doubt continue to be improvements along these lines, since we are only within recent years becoming acquainted with the feeding habits of the insects in relation to the toxic substances placed on the trees, comparative kill obtained with different products, freedom from spray burn, and many other points essential to the effective and economical use of available poisons. The arsenate of leads which have replaced all other stomach poisons for killing orchard insects, have been developed to a high state of perfection as regards mechanical condition and adhesion; and much more cannot apparently be expected in the poisons themselves. There still remains, however, the possibility by additions of making them attractive for the particular insect, increasing their stay on the trees long enough to cover the period of activity of the pest, or of increasing the thickness of the coating or palatability in some way in order to obtain more satisfactory results.

All poison work as well as other controls, however, must be definitely founded on biological data obtained in the vicinity. It is, for instance, important to know that beetles begin to emerge from hibernation in Connecticut about the first of May or when most apple trees are in the pink bud stage; that they become most abundant on the trees about the 15th or 20th of May (about the time when the blossoms have fallen) and that their period of greatest activity apparently lasts till the middle or last of June, the egg-laying period extending to the second week of July. It is also important to know that larvae develop abundantly in early apple drops and that they begin to leave this fruit the latter part of June, the majority entering the soil by the middle of July and few or none remaining by the first of August; furthermore that beetles again begin to emerge from the soil by the first of August or a little before, but that their maximum emergence appears to lie between the 15th of August and first of September, the beetles hibernating shortly after with a relatively small amount of fall feeding.

Of the control measures commonly practiced, the following may be mentioned: (1) cultural practices, or care of drop fruits—one of the oldest means of control and a very important adjunct to spraying practices especially where curculios are abundant—and one very commonly neglected. To be successful, cultivation

should be completed by the first of August, or if drop fruits only are handled, the operation should probably be complete by the first of July. (2) Spring and early summer applications of arsenicals. To be successful these must be considered from the standpoint of the growing tree and fruit (the tree must be kept thoroughly covered with poison at this time), and from the standpoint of the relative abundance of beetles on the trees. A schedule comprising pink, calyx, 7-day after calyx, and two weeks after calyx, all with arsenate of lead, meets these requirements and will apparently be successful in producing a satisfactory majority (90 per cent.) of clean fruit where the infestation is light or medium. If, however, the infestation is very heavy, even the complete schedule may fail to give the desired freedom and it becomes necessary to apply additional measures to secure relief. Moreover, in some orchards it may be difficult to get over the orchard once a week at the critical time, in which case there are several possibilities. The owner may apply cultural practices as outlined or take care of drop fruit (which if collected should be buried to a depth of two feet so the beetles will not emerge); in small orchards it would be possible to jar the beetles from the trees, collecting and destroying them—a method seldom practiced to-day; or it is possible to spray or dust again in the fall after the beetles have emerged as recommended by Snapp; the latter method offers one serious objection in the case of apples, in that sprays at this time might remain on the fruit at picking time. In the case of peaches or plums, however, this difficulty is not apparent and many beetles can doubtless be killed with a late spray since they feed on the leaves after the fruit is off. (3) There is still another possibility, namely: the treatment of wild apple trees which usually produce annually large numbers of curculios, or the treatment of abandoned or uncared-for orchards which are a decided menace when near a commercial orchard. We have examined many such trees in the neighborhood of well-kept orchards and there can be little doubt that curculios develop there and fly into the commercial orchard, adding much to the troubles of the grower. Hibernating quarters such as fence rows should be cleaned up and stone walls removed if possible.

Two years' experimentation with sprays together with data accumulated by this Department in connection with other work indicate that continued applications year after year give increasing percentages of clean fruit. However during six years' experimental spraying[1] in one of our orchards at Mount Carmel, the desired freedom was secured only after removal of a neighboring peach orchard, (which normally received no arsenical sprays), use of programs planned especially to control curculio, and sys-

[1] Experimental curculio spraying begun in 1924.

tematic collection of early drop fruits from the apples. Data on spraying operations are slowly accumulating under a five-year program and it may be that something will develop that will work effectively in the case of severe infestations without the need of supplementary operations. The difficulties, however, become apparent when we realize that the tree is growing most rapidly at the time of the greatest abundance of the pest, that the average sprays show some repellent action and even if most of the beetles in an orchard are killed, many may come in from outside sources—unless those danger points are considered and treatment provided.

The following bibliography of Experiment Station and other publications dealing with the curculio problem is given as it shows the opinions of State and Federal workers on the subject. It is from these sources that many of the recommendations found in literature to-day are taken.

1905. Crandall, C. S. Illinois Agricultural Experiment Station, Bulletin No. 98. Extensive account of apple and plum curculios with detailed field experiments for control. Spraying operations considered unsuccessful—cultivation recommended.

1906. Crandall, C. S. *Ibid.*, Bulletin *106*, pp. *219-231.*

1921. Fernald, H. T. In Applied Entomology, pp. *137-139*. *Control* (p. *138*). "No one method nor even all the methods of control taken together will give entire freedom from this pest. A combination of the treatments however, will accomplish considerable in this line." Recommends removal of rubbish and hibernating quarters; (2) pruning trees to allow sunlight to enter; (3) allowing fowls and hogs to run under trees or through shallow cultivation from time larvae begin to leave fruit till six weeks later; (4) spraying with arsenate of lead "for apples—treatment commonly given for codling moth though similar later applications may also be necessary if the insects are abundant"; (5) jarring the trees and collecting the beetles when only a few trees are involved.

1906. Forbes, S. A. Illinois Agricultural Experiment Station, Bulletin 108. Used arsenicals in field tests against the curculio on apples with an average increase of 63 per cent. sound fruit over untreated trees.

1914. Headlee, T. J. Report of the Department of Entomology, New *Jersey Agricultural Experiment Station for 1913, p. 654.* States that where curculio is present foliage must be kept covered with arsenical from time the "creature begins to feed until it disappears." Overwintering beetles remain in plum orchards about six weeks, in apple orchards for about a month.

1918. Headlee, T. J. *Ibid.*, Report for 1917, pp. 437-438. "Attack seems to have come between the blossom-fall and the ten-days-after-blossom-fall spraying." "In orchards standing near woodlands or plantings interspersed with old stumps or carpeted with grass, the damage was particularly severe." Recommends clean culture during forepart of season followed by cover crop not producing a dense sod, removal of stumps and cleaning of fence rows. Recommends spraying to preserve the coating intact for the first month after blossoms fall.

1919. Headlee, T. J. *Ibid.*, Report for 1918, pp. 212-213. Recommends 7-day spray after calyx. Records two successful cases of control in orchards where curculios were abundant and where crop unsprayed was "ruined by the curculio." Recommends as a schedule for curculio control

(1) before buds swell; (2) as blossom buds first show color; (3) directly after petals fall; (4) seven days later; (5) 17 days after blossoms fall; (6) June 20 to 30 for all fall and winter varieties. Better results obtained with lime-sulphur and arsenate of lead than with arsenate of lead alone; both have repellent action.

1921. Headlee, T. J. *Ibid.*, Report for 1920, p. 449. Table showing comparison of dust and spray on apples unsatisfactory control of curculios indicated with dust. Seven to nine per cent. injured by curculio.

1923. Headlee, T. J. *Ibid.*, Report for 1922, p. 373. Table showing comparison of dust and spray on apples including curculio records. Dusts do not control curculio as well as sprays.

1924. Headlee, T. J. Ibid., Report for 1923, pp. 276-278, Tables 6, 7 and 8. Results of curculio spraying.

1925. Herrick, Glenn W. In Manual of Injurious Insects, pp. 156-157. "*Control measures.*—All fence rows, hedge rows, and stone walls should be removed from about an orchard. Sunlight on the fallen fruit is fatal to the larvae within, hence judicious pruning to let in the light is useful. Cultivation during late July and early August will destroy pupae in the soil. Thorough spraying with arsenate of lead two pounds to one hundred gallons of water just after the petals fall and again ten days later will be effective if the hibernating places have been destroyed."

1918. Pickett, B. S., Watkins, O. S., Ruth, W. A., and Gunderson, A. J. Illinois Agricultural Experiment Station, Bulletin 206. Contains much valuable information on orchard sprays for the curculio and their results are ably discussed in tables and text. Page 492, under General Summary: "Codling moth and curculio, as a rule, were well controlled by applications of arsenate of lead." Page 493, controls obtained "from 60 to 94 per cent. (in the most successful experiments in 1913) and the least effectively sprayed plats from 32 to 79 per cent. In 1914 the most effectively sprayed plats showed controls ranging from 81 to 97 per cent. and the least effectively sprayed plats from 45 to 87 per cent. In no case did spraying with arsenate of lead fail to exercise a decidedly beneficial effect."

1912. Quaintance, A. L. and Jenne, E. L. U. S. Department of Agriculture Bulletin No. 103. The most extensive single publication on the plum curculio and its control yet published. Contains summaries of all previous work data on life history and parasites and accurate studies of control measures. Page 200 under conclusions: "With a small amount of fruit and abundance of curculios the most thorough spraying will not serve to bring through a satisfactory amount of sound fruit"—"with a large crop of fruit and abundance of insects, results will likewise be disappointing." Recommends four sprays for apples using dilute fungicide and lead arsenate: (1) as cluster buds are out; (2) as petals fall; (3) three or four weeks after petals fall; (4) nine or ten weeks after petals fall. Secured controls amounting to from 19 to 77 per cent. increase in sound fruit from sprays tested. The best figures show 91.07 per cent. sound fruit as a maximum obtained by the method advocated.

1922. Quaintance, A. L. and Siegler, E. H. U. S. Department of Agriculture, Farmers' Bulletin 1270, pp. 7-10. "Most practical means of control are spraying with arsenate of lead, and cleaning up of trash from the orchards and vicinity as well as through cultivation during the summer—the prompt collection and destruction of infested fallen fruit will also aid in reducing this pest." The first spray application to poison the beetles should be applied in pink cluster bud stage, and the second as soon as the petals have dropped, using arsenate of lead at the rate of 1 pound of powder or 2 pounds of paste to 50 gallons of water or fungicide. Supplemental treatments are desirable in orchards where the curculio is more than ordinarily destructive.

1914. Singerland, M. V. and Crosby, C. R. Manual of Fruit Insects, pp. 243-251. Recommends for apples: two sprays as for codling moth just after petals fall and three weeks later—"but where the infestation is severe additional applications will be found necessary." Thoroughness of spraying is essential. Reliance should not be placed on any one method of attack. Clean cultivation, proper pruning, thorough cultivation at proper time are necessary.

1922. Snapp, O. I., Turner, William F., Roberts, J. W. U. S. Department of Agriculture Circular 216. Decribes methods used for controlling curculio in the Georgia fruit belt. Recommends destruction of early drops or disking to destroy pupae, and proper orchard sanitation. Jarring the trees also mentioned.

1924. Snapp, O. I., and Alden, C. H. U. S. Department of Agriculture, Bulletin 1205. Dusting and spraying peach trees after harvest for control of the plum curculio. General summary, p. 17: "Post-harvest treatments are not advisable except in cases where the curculio infestation has been severe during the peach season." Two applications of 10 per cent. lead arsenate and 90 per cent. hydrated lime dust are recommended for these treatments.

TESTS OF ALCOHOL-FORMALIN FOR CONTROL OF AMERICAN FOUL BROOD IN BEES

PHILIP GARMAN

Several combs containing American foul brood were received from two different sources in 1925, and treated with Hutzelman's solution or various modifications thereof, with the following results:

1. Comb received May 28 and examined carefully; gross characters were positive for American foul brood; microscopical examination positive; cultures made on egg-yolk agar—apparently positive in manner of growth and morphology of the organism. Treated with homemade Hutzelman's solution containing one-half gallon formaldehyde (40 per cent.) and two gallons of alcohol (completely denatured formula number 5). The comb was placed in a small three frame hive. It was examined August 4 by Inspectors Yates and Coley and no disease was found. The combs continued clean throughout the summer and on September 24 a full sheet of brood had been formed. There was no evidence of the disease or injury from the treatment.

2. A comb received May 28; gross characters positive; microscopical picture and cultural features positive. Treated with formaldehyde (40 per cent.), one-half gallon, and water two gallons. A full sheet of brood was allowed to develop and the colony dequeened. No sign of the disease was seen and no scales could be found after brood was out. Examined August 4 by our inspectors; no disease found.

3. Comb from same source as Nos. 1 and 2; gross characters, microscopical picture, and cultural features positive. Treated with Hutzelman's solution, commercial product. Continued brood rearing throughout the summer, the comb being examined

August 4, and found free of disease; comb continued clean throughout the summer and examination September 24 showed no disease.

4. Comb received June 19, from another source—fairly rotten with American foul brood. Gross characters and microscopical picture positive. Cultures not made. Comb treated with commercial Hutzelman's solution without uncapping brood, but after extracting honey. Soaked 48 hours; examined September 24, and no diseased brood was found.

Combs treated in 1924 were kept under observation and no signs of American foul brood developed. Two combs treated with homemade Hutzelman's solution in 1924 the same as No. 1, above, were found to be freely used by the bees for brood rearing and storing honey. One other comb, however, treated with paraformaldehyde, the latter being left in the comb, remained throughout the season without brood and with very little honey. Although placed in a very strong colony, the bees seemed to ignore this comb and would have nothing to do with it. It apparently retained enough paraformaldehyde to be objectionable, although it had no deleterious effect upon the colony as a whole.

Several other combs were treated by similar methods but results so far have been similar to those already described and no description of them will be attempted.

THE PEAR PSYLLA IN CONNECTICUT

Psylla pyricola Forster

PHILIP GARMAN

By far the most important enemy of pears to-day in Connecticut is the pear psylla. It is reported to have been introduced into this State from Europe about 1832 and is now found throughout the northeastern United States. Much and serious damage may result from an infestation, the leaves becoming stunted and black or sooty, many dropping prematurely. The fruit may become discolored and remain undersize and the fruit buds may be affected, resulting in a decreased yield the following year. Pear psyllas are present in many Connecticut orchards and cause considerable damage every year.

Life History: The winter is passed in the adult stage, the insects hiding under the bark usually near the ground, but also in other places. They emerge during warm days in spring and lay their eggs on growing shoots. According to published records, the eggs hatch in 12 to 18 days and the nymphs mature in about a month. Eggs of the second brood hatch in about 12 days and there are reported to be three or four broods in New York State (Hartzell). The separate broods are completed in about a month and a half.

The Different Stages: The egg is a small yellow pyriform object about one-eightieth of an inch in length, and under proper magnification may be seen to possess a short stalk at the larger end and a small thread at the other. The nymph is very much flattened, with very large rounded wing pads, and is able to secrete quantities of honey-dew in the early stages. There are reported to be five immature nymphal stages, the first three of which secrete honey-dew in which grows a black sooty mold responsible for the disgusting appearance of trees that are heavily infested.

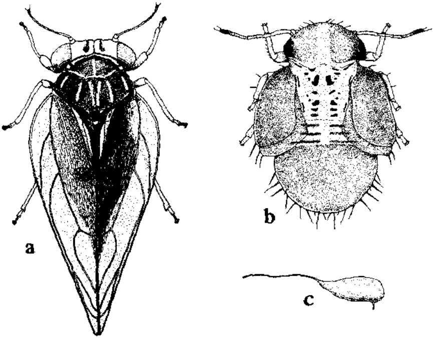


FIG. 43.—The Pear Psylla, *Psylla pyricola*. a. adult; b. nymph; c. egg. Enlarged about 25 times.

The adult is a small winged insect somewhat resembling a small fly or gnat when on the wing, but when magnified resembling a cicada in miniature. The egg, nymph and adult are shown in Figure 43, and egg on Plate XX, a.

Biology and Control Measures: In controlling the pest there are several points to be considered. First: the nymphs do not hibernate until late fall and they emerge very early in the spring, after a few days of warm weather. Headlee states that they may be found frequently in cool weather clinging to the smaller twigs "too stiff to move" and a spray with miscible oils or soaps and nicotine at this time should be very effective. The same condition exists in the spring after the insects have emerged from hibernation, which condition affords an opportunity to finish the spray, if not completed in the fall. The second point to be kept in mind is that the insects continue to lay eggs well up until the

cluster buds of most varieties begin to separate and in some cases even longer—so that dormant sprays must be delayed as long as possible at this period in order to kill the greatest number Thoroughness at this time is very essential. Even these sprays however, (the dormant with miscible oil or soap and nicotine, and the delayed dormant egg spray of lime-sulphur at the cluster bud stage) may not kill a sufficient number to protect the orchard throughout the summer and other treatments must usually be considered if commercial control is secured. One of the most successful summer sprays developed thus far is the Bordeaux-nicotine-sulphate (Hartzell) spray applied at the calyx or petal fal

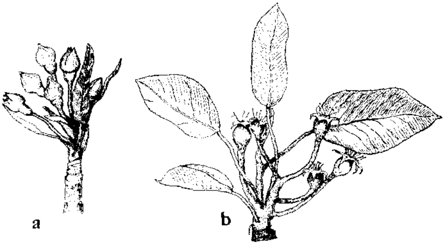


FIG. 44.—a. Pear blossom buds at proper stage for delayed dormant spray of lime-sulphur 1 to 8. b. Time for first application of heavy lime bordeaux or heavy lime-dry-mix.

period and often repeated in July. This spray has a decided effect in checking the development of the nymphs and has been used successfully in some Connecticut orchards. Others make use of a self-boiled lime-sulphur or dry mix formula with added nicotine. since pears usually need some form of fungicide to check scab or other diseases. It is very generally recognized, however, that commercial lime-sulphur is liable to burn the foliage severely if used as a summer spray. In general, considering work done in neighboring States, the following spray program for Connecticut is suggested as one likely to give the best results.

(1) In fall or spring when the temperature is above freezing and adult psylla are found on the twigs "too stiff to move,"—miscible oil 1 to 15, or nicotine sulphate 1 pint in 100 gallons with 4 pounds of soap added.

(2) When the blossom buds begin to separate in the cluster,—lime-sulphur (commercial 33° Be) 1 part in 8 parts of water. (See Figure 44, a.)

(3) At the calyx or petal fall period soon after the blossoms have fallen,—Bordeaux-nicotine-sulphate mixture composed of 2 pounds of copper sulphate, 40 pounds hydrated lime, and 1 pint of nicotine sulphate in 100 gallons of water; or dry mix consisting of superfine sulphur, 16 pounds, hydrated lime 8 pounds, and calcium caseinate 1 pound. The dry mix is first mixed with a small amount of water in the spray tank, 1 pint nicotine sulphate and 32 pounds hydrated lime are added, and the whole made up to 100 gallons. (See Figure 44, b.)

(4) Same as No. 3, to be repeated in July if the nymphs become numerous.

Some growers maintain that after control is once secured and the insects are reduced in numbers sufficiently, the winter spray can be safely omitted. In cases of severe infestations all sprays should be employed and great thoroughness exercised in making the applications.

Much experimental work has been done with control of adult psylla by means of nicotine and cyanide dusts. While not yet studied sufficiently to make definite statements regarding them, it seems probable that they will become useful weapons in the hands of the grower.

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OUTBREAK OF PEA APHID ON ALFALFA

B. H. Walden

One of the unusual insect problems in Connecticut during 1925 was the injury caused to alfalfa by aphids. On May 13, Mr. Raymond K. Clapp, Agent of the New Haven County Farm Bureau, called at the Department to obtain information regarding the control of aphids on alfalfa, stating that a field in Seymour belonging to Mr. Elmer R. Meade was badly infested and that many of the plants were turning yellow.

As this was the first time that our attention had been called to

insect injury to alfalfa, a visit was made to the field on May 14. Fully half an acre near the center of a three-acre field was badly infested with large green aphids. Some of the plants, though still green, had the leaves curled and the growth was apparently checked; others had turned yellow and many were completely dried up; even the crown appeared to be dead. Many aphids were found throughout the remainder of the field, though the plants had not been seriously injured.

The identity of the species could not be determined in the field and material was collected and brought to the laboratory for study. It was suspected, however, that this was the pea aphid, which is known to live part of the season on various clovers, often causing considerable damage, and which has been taken on alfalfa, although according to Davis* the pea aphid was not formerly considered a serious pest of alfalfa. It was later found upon examining the insects under the microscope that this was the pea aphid, *Illinoia pisi* Kalt.

During the warm part of the previous day, Mr. Meade dusted a small section of the field with 2.7 per cent. nicotine dust, applied with a hand duster. The plants still showed a good coating of dust and there were many dead aphids on the ground, but there appeared to be about as many live ones on the plants, indicating that it would take more than one treatment to control the aphids. It was evident that it would not be practicable to treat the whole field with a hand duster, and Mr. Meade questioned whether the value of the crop would warrant two applications of dust, using a power duster.

Normally the alfalfa would not be cut for two or three weeks, but it was suggested that if the aphids remained on the plants and the injury increased, it would be well to cut it early, as the cutting and curing of the hay would kill many of the aphids and expose the survivors to the direct sunlight. A number of aphids that had been parasitized were observed. Lady beetle larvae and Syrphid larvae were present in limited numbers. No aphids which had been attacked by fungus were observed at that time.

On May 15, another field of alfalfa belonging to Doody Brothers of North Branford was examined. About one acre of three or four year old alfalfa was found to be infested with the pea aphid. Occasional plants were turning yellow, but the injury was not as severe as at Seymour. This field had suffered from drought the previous fall and the plants had not made a thrifty growth.

Some of the aphids were parasitized and many of them had been killed by a fungus, probably *Empusa aphidis*.

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* The Pea Aphis with Relation to Forage Crops, J. J. Davis, U. S. Department of Agriculture Bulletin 276, 1915.

Adjoining this piece of alfalfa was a five-acre field of younger plants. Many aphids were present near the margin next to the older field but the plants were more vigorous and showed very little injury. A second visit was made to the field on May 19. The condition of the plants appeared to be about the same as on May 15, but more than one-half of the aphids had been killed by the fungus. On May 28, the injury to the plants had not materially increased. Another generation of aphids was present and though the fungus did not seem to be increasing, a larger proportion of the aphids had been attacked by Hymenopterous parasites. The infestation had extended further into the younger field of alfalfa, but these plants did not as yet show any serious injury.

Reports of injury to alfalfa on three farms in Hartford County were received from Mr. B. G. Southwick, County Agent. These infestations were investigated on May 20. A field in East Windsor of about one acre owned by Mr. H. F. Barber was injured by drought during 1924 and came through the winter in poor shape. After the plants were found to be infested with aphids, the owner plowed the alfalfa under in order to use the land for some other crop.

About two acres of alfalfa belonging to Mr. G. A. Stoddard of West Simsbury were noticeably injured towards one end of the field where there was a pocket or depression in the surface of the field which may have held water and caused more or less winter injury to the crop. While aphids had been present over the whole field there were very few alive on May 20. A large percentage had been killed by fungus. Mr. Stoddard considered that the injury was practically over.

Mr. O. D. Fuller, a neighbor of Mr. Stoddard, owned the field where the third infestation was reported by Mr. Southwick. This was not seen by the writer, but Mr. Fuller stated that the conditions were similar, though the injury was somewhat less than in Mr. Stoddard's field.

Specimens of the pea aphid on alfalfa were brought into the office from Middletown on May 23. There were many specimens on the stems and leaves, but a large proportion of them had been attacked by the fungus.

Another report of aphids on alfalfa was received from Woodbridge but this infestation was not examined.

From observations made in these fields, it was quite evident that the plants most seriously injured by the aphids were those which had been weakened either by drought or winter injury. Many of the most vigorously growing plants, though badly infested with aphids, did not appear to be noticeably checked. It has also been observed that thrifty fields of red clover can stand comparatively heavy infestations without showing noticeable

injury. It is impossible to predict whether or not the pea aphid will injure alfalfa again in 1926.

According to Davis, (l. c.) the pea aphid was introduced from Europe and reported as occurring in this country in 1878-79, although the first report of serious injury to peas was some 20 yeas later, in 1899. In 1907, the species was collected on alfalfa in Arkansas, but as late as 1915, Davis states that *M. sativa* (alfalfa) is not universally and commonly attacked by the pea aphid.

In 1921, however, the pea aphid was reported as injuring alfalfa in Colorado, Kansas, Missouri, Nebraska, Oklahoma, and Oregon.* In 1923 it was reported as infesting alfalfa in 12 states, and during the past season it was reported from six states besides Connecticut.

The pea aphid in the north passes the winter as small shiny black eggs on the stems of clovers. The eggs hatch early in spring and there are about 12 generations during the season. Some of the individuals usually remain on clover throughout the year. In years when they are abundant, about July 1 in Connecticut, the majority of the aphids migrate to peas.

The pea aphid has an unusually large number of natural enemies. The most important natural check is probably the aphid fungus *Empusa aphidis*. This was very abundant in the alfalfa fields in North Branford and West Simsbury and the specimens from Middletown showed many individuals which were infested with this disease. The appearance of aphids attacked by this fungus is shown on Plate XVIII. Many lady beetle larvae and larvae of Syrphid flies were feeding on the aphids in the various fields. Aphids that had been attacked by Hymenopterous parasites as shown on Plate XVII, b, were found in all the fields examined. Three species of these parasites were reared, and later determined by the U. S. Bureau of Entomology, as *Aphidius rosae* Haliday, *Megorismus fletcheri* Crawford and *Lygocerus niger* Howard. The first mentioned species was by far the most abundant.

INJURY TO APPLES BY THE RED BANDED LEAF-ROLLER AND ITS CONTROL

B. H. Walden

Injury to apples similar to that shown in Figure 45 has been frequent in Connecticut orchards during the past few years and is due to the work of the red banded leaf-roller, *Eulia velutinana* Walker, which feeds at the surface of the fruit. The injury is apparent at picking when the greenish larvae are often found at

* Insect Pest Survey Bulletin, Vol. 1, 3, 4, 1921-1924.

work beneath where a leaf had rested against the fruit or where two apples have touched when on the tree. The larvae also readily attack the fruit where there is no protection, working beneath a thin whitish web secreted by the larvae. The injury is frequently on the side of the apple, and the growers often call the trouble "side worm injury." The larvae, however, readily feed around the calyx and occasionally around the stem. Fruit thus injured gives trouble in storage since the injury occurring late in the season does not heal over and affords an entrance for rot-producing organisms.

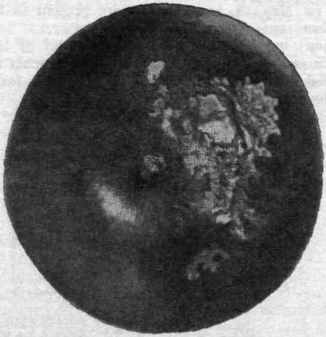

FIG. 45.—Work of red banded leaf-roller on fruit, natural size.

If any of the larvae are present on the fruit when stored, the injured area is often increased by further feeding, or the larvae may leave these apples and attack sound fruit.

Several other insects cause somewhat similar injuries on the surface of the fruit, but these can usually be distinguished from that of the red banded leaf-roller. The work of the lesser apple worm is often confused with that of this insect. The injury may be much the same shape but the lesser apple worm does not eat the skin of the fruit, but mines just beneath and when partly grown may tunnel into the core, while larvae of the red banded leaf-roller readily eat the skin and the injury is confined to the surface of the fruit.

Second brood codling moth larvae may feed on the surface but

eat much smaller areas and soon tunnel into the fruit. The larvae of the red banded leaf-roller are light green in color with yellowish-brown heads, while the larvae of the codling moth and lesser apple worm are of a white or pinkish color with much darker brown heads.

The life history of the red banded leaf-roller has not been carefully worked out for Connecticut, but will probably be similar to the observations made in Pennsylvania,* where it has been found that this insect passes the winter in the pupa stage. Adults emerged in the spring and were most abundant in the orchard from May 4 to May 16. Eggs deposited on the branches May 11 hatched on May 18, and larvae were present in the orchard from that date until November 1.

Observations have been made on the control of injury from this insect in onr dusting and spraying experiments at Milford Data collected in 1922 is given in Table I. The formulas used were as follows:

SPRAY

Commercial lime-sulphur ..	3 gallons
Lead arsenate (dry)	3 pounds
Nicotine sulphate	¾ pint
Water	100 gallons

DUST

Dusting sulphur	65 per cent.
Lead arsenate	10 per cent.
Nicotine sulphate	5 per cent.
Carrier	20 per cent.

TABLE I.

Plot	Treatment	Total Number of Apples	Per cent. of Injury by *Eulia*
1.	5 sprays, April 19, May 22, June 14, June 30, July 20	6,760	.32
2.	3 sprays, April 19, May 22, June 14	6,072	.69
3.	5 dust, April 19, May 22, June 14, June 30, July 20	4,881	.74
4.	3 dust, April 19, May 22, June 14 ..	3,137	.92
5.	Check	1,673	5.47

All plots shown in the table received three applications as follows: April 19, May 22 and June 14; while plots 1 and 3 received two extra applications on June 30 and July 20.

* Pennsylvania Agricultural Experiment Station Bulletin 169, p. 11, 1921.

Though the figures are not striking, the sprays were somewhat more effective than the dust treatments and where five sprays were given, the injury was reduced about one-half over three applications.

The results obtained in 1925 in the Milford orchard with spray in comparison with dust and combination spray and dust treatments are given in Table II. The following formulas were used:

SPRAY FORMULA

Lime-sulphur (dry)	6 pounds
Lead arsenate (dry)	3 pounds
Kayso	1 pound
Water	100 gallons

DUST FORMULA

Dusting sulphur	90 pounds
Lead arsenate	10 pounds

TABLE II.

Plot	Treatment	Total Number of Apples	Per cent, marked by *Eulia*
1.	Spray with Kayso, May 1, May 19, June 2-3, July 1, July 26	6,424	.3
2.	Spray without Kayso, same dates as above	3,600	.4
3.	90-10 sulphur-arsenate dust, May 1, May 19, June 2-3, July 1, July 26 ...	4,293	1.7
4.	4 dust applications between May 1 and July 1. 1 spray, July 26	5,285	.5
5.	Spray, May 1; Dust, May 19; Spray June 2-3; Dust, July 1; Spray, July 26	1,959	.5
6.	Spray, May 1, May 19; Dust, June 2-3, July 1, July 26	7,005	1.1
7.	Check, no treatment	2,250	11.2

Although all treatments gave fairly good control, the sprays (plots 1 and 2) gave the best control and the combination treatments with late sprays (plots 4 and 5) were next.

It is evident that if the red banded leaf-roller continues to be prevalent in certain seasons, that it will be necessary to spray apple orchards later than has been the general practice. In case the apple maggot and the apple and thorn skeletonizer are present, the same treatment should help control them.

THE RASPBERRY FRUIT WORM, BYTURUS UNICOLOR SAY, INJURING STRAWBERRY BLOSSOMS

B. H. Walden

On May 22, a visit was made by request to the fruit farm of Mr. C. Bussa at South Glastonbury, to examine some strawberries which were being injured by beetles feeding upon the blossoms. On several rows of Stevens, a late variety which was just beginning to bloom, adults of the raspberry fruit worm, *Byturus unicolor* Say, were feeding on the petals and centers of the blossoms as shown on Plate IX, a.

The plants on the opposite side of the field were uninjured, although there was a block of red raspberries a short distance beyond. As there were no raspberries near the infested side of the strawberry field, the situation was rather puzzling until the owner explained that there had been a badly infested raspberry field on this side which was removed in the spring. A large number of the beetles had evidently wintered in the soil and upon coming out in the spring were forced to feed upon the strawberries, in the absence of their natural food plant.

As there were only a small proportion of the strawberry blossoms open and no honey bees observed in the field, it was suggested that spraying at once with lead arsenate might help to check further injury.

The field was examined again on June 5. Though the owner had not sprayed the plants, the beetles had nearly all disappeared. No eggs were found on the strawberries, although beetles and eggs were present at this time on the raspberry plants.

The injury to the strawberries was probably less than it would have been to an earlier variety. There were a few less berries set on these rows than on the uninfested ones, and some of the first set fruit was deformed. The fact that there were fewer berries at the first picking would give the later berries a chance to grow larger than if there had been a full crop, so that it was hard to estimate the actual damage by the beetles. It probably did not exceed 10 per cent.

This is the first time that raspberry beetles have been observed feeding on strawberries in Connecticut and it was undoubtedly due to the removal of the adjoining raspberry field. There will probably be little or no damage to the strawberries next season as there were no indications that the raspberry beetles would develop on strawberries.

THE EUROPEAN CORN BORER IN CONNECTICUT

Pyrausta nubilalis Hubner

M. P. Zappe

This destructive insect was first discovered in Connecticut late in the fall of 1923. At this time Federal scouts found three small separate infestations along the shore region of Connecticut in the eastern part of the State, two in the town of Groton, and one in Niantic in the town of East Lyme. These were cleaned up and most of the infested material burned in the fall of 1923, the work being finished in the spring of 1924. No larvae of the European corn borer were found at these infestations the following year.

During the summer and fall of 1924, seven separate infestations of this insect were found in six shore towns of Connecticut by Federal scouts, in the following locations: Bridgeport, in a corn field at Hillside Home in the northeastern portion of the city; New Haven, at Granniss Corner, infestation in small gardens; Old Lyme, in a small corn field on the eastern side of the town; East Lyme, in a large field of corn near Crescent Beach; Groton, in a small corn field about one mile north of the Town Hall; Stonington, two infestations in small gardens in the village of Mystic.

Clean-up work began on December 1, and was completed December 12. This consisted of burning all corn and weed stems in the infestations and in surrounding fields and gardens. A total of 5,485 gallons of fuel oil was burned. An account of this clean-up work may be found in the Report of this Station for 1924, page 277.

In the summer of 1925, the scouting covered all the shore towns of Connecticut and also included the town of Orange and a part of the town of Woodbridge, which, together with Milford, forms an area where quantities of seed corn are grown and it was deemed advisable to have this area examined. All scouting in 1925 was done by Federal scouts, but the State of Connecticut co-operated by paying one-half of the wages of these men while scouting within the State. Besides the infestations of European corn borer found, 509 larvae were sent to the Federal laboratory at Arlington, Mass., and identified as not being the European corn borer.

Infestations of 1925

The scouting work of 1925 revealed the presence of the European corn borer in 20 separate infestations in the following five towns: Bridgeport, Saybrook, New London, Groton and Stonington. Nothing was found around the last year's infestations in New Haven, Old Lyme and East Lyme, these points being entirely free from any infestation.

Bridgeport Infestation

An infestation was found at Hillside Home near last year's infestation where European corn borer larvae were found in stems of smartweed in 1924. The clean-up work last year was not entirely satisfactory. The Superintendent of the Home promised to assist by having his men throw corn stalks, stubble and weeds into piles to make the burning easier. The men doing the work tried to plow out the stubble and as a result, some of it was left just below the surface of the ground where the larvae were safe from the fire.

This season the Superintendent had the corn fields plowed, the work being supervised by Federal men who followed the plow and threw all stubble and corn stalks into the furrow where the plow could cover it deeply on its next trip. This proved satisfactory and most of the material was well covered. After plowing, every bit of stubble, corn stalks or weeds that could be found above ground was collected into piles and burned. All weed areas within a reasonable distance of the infested fields and all weeds around fences, barns, and in a dump nearby were burned. Five entire days were spent in actual burning at this infestation by a force of 10 men, besides parts of several other days spent on clean-up work preparatory to burning. In all, 428,475 square feet of land was burned over, and 5,670 gallons of fuel oil were used. The work was finished on December 11, 1925.

Saybrook Infestation

This infestation was found in sweet corn growing in a garden just west of Oyster River on the State road betwen New Haven and New London. Part of one day was spent in clean-up work before burning. Eight men spent part of one day in burning, using about 300 gallons of fuel oil. About 10,800 square feet of ground was burned over, but operations at this infestation are not completed, as there are still two nearby gardens to be covered. We hope to finish work here early in the spring of 1926.

New London Infestation

This infestation was situated in the northern part of New London just inside the city limits. It was found in a large field of field corn owned by Mr. J. J. Higgins. This was a heavy infestation, 18 larvae being found in a very short time, all of which proved to be the European corn borer. There were no other fields of corn near the infested field and only a few small gardens. some of which had corn stalks in them. These were all included in the burning program. About 60 large shocks of corn were burned, as well as all stubble which had previously been dug out of the ground and soil removed from the roots. Weeds

and trash around the infested field, and other material which might harbor the larvae were burned in about eight nearby gardens. Two men spent two days in preparatory work and 11 men spent two whole days burning up this material. A total of 1,789 gallons of oil was consumed here, burning over an area of about 256,200 square feet. Work was completed on December 15, 1925.

GROTON INFESTATIONS

In the town of Groton, a total of eight infestations was found. Two of these were in the borough of Groton, one at 50 Pleasant Street, west of the house of George Hempstead, where two larvae were collected in sweet corn; the other was at 97 Baker Avenue, in the garden of Mrs. J. E. Lamb, where a total of 10 larvae were collected in a small patch of sweet corn.

The preparatory work was done by five men working for two days on both infestations. These two infestations, being in the borough where nearly everyone has a garden, several adjoining gardens on both sides of each street were also cleaned up and burned. This required the time of 11 men for two and one-half days, it being necessary to burn over 172,855 square feet of land, using 1,921 gallons of fuel oil. Work on these two infestations was completed on December 18.

Owing to the fact that these infestations were in a thickly populated section of the town and that there was danger of setting fire to some of the many out-houses, chicken coops, fences, etc., it was thought advisable to have some fire-fighting apparatus immediately available if needed. One of the gipsy moth power sprayers was sent down from the State storehouse at Danielson, the tank filled with water, hose coupled together, and ready for use if occasion should require it.

In the section of Groton known as Noank, there were five separate infestations. Two of these were on Spicer Avenue, where 19 larvae were collected in sweet corn in small gardens; another was on Shore Street, where seven larvae were collected in sweet corn in a small back-yard garden. Another one was found in a good sized patch of sweet corn near the corner of Main and Church Streets, where 14 larvae were dug out of sweet corn.

An infestation was also found on Brook Street, Noank, where one larva and one pupa were found. Several corn stalks were found that showed the work of the European corn borer, but the larvae had pupated.

Some of the preliminary work has been done at the Noank infestations, but no actual burning has taken place on account of the area becoming covered with snow and ice. This area will have to be left until spring before it can be burned.

Two other infestations found in the town of Groton are located just at the western edge of the village of Mystic on what is known

as Baptist Hill on the State road to New London. These were both in back-yard gardens, where a total of 12 larvae were found in sweet corn. These infestations have been prepared for burning *but no actual burning* has been done. Many adjoining gardens have also been cleaned and material in them will be burned this coming spring.

Still another infestation in Groton occurs in the garden of Mr. J. M. Whitman at 13 Grove Avenue, Mystic, where two larvae of the European corn borer were found. No control work has been done at this infestation but we expect to complete the clean-up work in the spring before the moths can emerge.

Stonington Infestations

In the town of Stonington five widely separated localities were found infested extending from the very eastern boundary of the town to the western edge in the village of Mystic. One was found in Pawcatuck, another at Lord's Hill, another on Pequotsepos road, still another on the Old Mystic road, while the infestation of several small back-yards on the Stonington side of Mystic may be considered to be the fifth. The latter infestation really consists of three small infestations near enongh together to be considered as one infestation. They are all located within a few blocks of each other on the east bank of the Mystic river north of the main street in Mystic. No clean-up work nor burning has been done here yet, but we expect to burn this coming spring all material which may harbor larvae of the European corn borer.

In 1924, there were two infestations in this neighborhood, and it is quite probable that more existed, that were not discovered and adults from these may have been responsible for the reinfestation. The work to be done here must necessarily cover quite a large area of ground in order to be sure that all infestations found have been burned as well as covering some additional land for a margin of safety.

Only one infestation in Stonington has been burned. This is situated on the Mystic-Old Mystic road, east of the river, where 20 larvae and 11 pupae were collected in a large patch of sweet corn. Mr. Edward A. Smith, the owner of the farm, grew sweet corn and cut flowers to sell to people who were summering at Groton Long Point. All corn sold and removed from this farm was inspected by Federal men, to prevent any possible spread from this infestation.

All corn, weed and flower stalks here were burned, as well as the corn stalks on the adjoining farm. It took 11 men four days to burn over 58,400 square feet of ground, using about 1,587 gallons of fuel oil.

Another infestation was found about one mile east of the Smith farm on the Pequotsepos road on land belonging to Mr. H. Wilcox. This was in a small patch of field corn and only three larvae were

found. The owner was allowed to feed the corn stalks to his cattle with the understanding that he would burn all stalks which the animals did not eat.

The stubble was dug and thrown on a pile of wood brush, etc., and though not yet burned, it will be very early in the spring and without oil if possible. As this infestation was quite distant from any other corn fields, it was not thought necessary to do any burning outside of the infestation itself. However, the owners of the adjoining farms promised to burn in the spring all corn stalks which the cows had not eaten during the winter.

About two miles west of Stonington village on the farm of James Lord at Lord's Hill, another infestation was found. This was in a large garden patch of sweet corn. Mr. Lord has been permitted to feed corn stalks from the infested fields to his cows, provided that he burns up all stalks left uneaten.

The corn stubble has all been dug from the ground and thrown into small heaps. A perennial garden just over the fence from the infested fields has also received attention; all flower stalks and weeds have been cut, raked and thrown over the fence into the corn field. An adjoining field of corn planted for ensilage and abandoned, contains much grass and weeds, which will also be burned in the spring when weather permits burning operations.

One infestation is located in lower Pawcatuck on land owned by Mr. W. E. Miner, where seven larvae were collected from a large patch of sweet corn. This corn patch is close to the Pawcatuck river, which is the boundary line between Rhode Island and Connecticut, and seems to be an isolated infestation, as the nearest known infestation is about five miles to the west.

The Pawcatuck infestation has been prepared for burning. The owner attempted to burn the corn stalks in the infested field, but was not entirely successful. These partially burned corn stalks have been gathered and weeds and grass cut off and raked away from fences and buildings preparatory to burning in the spring.

Extension Work

Before any actual clean-up work was started, it was thought advisable to enlist the co-operation of the householders near the infestations and ask them to clean their own yards and gardens by burning weeds, corn stalks, etc. If they could be induced to take care of their own yards, it would mean a considerable saving of work and expense for the State, as well as to reduce the chances of missing any undiscovered borers in material around the present known infestations. The territory which the State could clean up would necessarily be limited to a few yards surrounding each infestation.

A house-to-house canvass was made, in a one mile radius around each of the infestations. Three men spent seven days on this work.

To save time in explaining to the householders what they were requested to do, the following notice was either given to each one or left at the door.

EUROPEAN CORN BORER HERE

Will You Co-operate?

Some of you may have seen men looking over your corn and other crops. These men were hunting for the European Corn Borer, a very destructive pest from Europe now occurring in Eastern New England and around Lake Erie.

This pest has recently been found in small numbers in your vicinity. There is grave danger that it may soon spread throughout the State. Every reasonable measure is being used to control it, but you can help.

All cornstalks should be destroyed:—if fed to cows, the thick stalks which the cows do not eat should be burned. All large weeds, dahlia stalks, and other flower stalks should likewise be burned.

Please cut your stalks off close to the ground and not leave stubble five or six inches high. Some of the borers may be in the stubble, and digging and burning the stubble is expensive. When cut off at the surface of the ground, the borers are all in the tops. A sharpened hoe is an effective tool for cutting the stalks.

The scouting and control work is done by the Federal Bureau of Entomology and the State Entomologist of Connecticut in co-operation.

Further information regarding the pest may be obtained from

W. E. Britton, State Entomologist,
P. O. Box 1106, New Haven, Conn.

This work was done early in October. At the time the burning work was finished in the latter part of December, only one householder had completely cleaned up all material which might harbor larvae of the European corn borer. Several others had attempted to burn their corn stalks, but only the leaves and tassels had been consumed. The most important parts of the corn, the thick stalks, had not been burned at all. Perhaps early in the spring, when the material is drier, the gardeners will have more success.

In Mystic and Noank, many people were in the habit of throwing old stalks, rubbish, etc., into the river. We tried to discourage this practice, as the material would only drift ashore and, if infested, might start other infestations perhaps miles away from the origin of the material.

Summary of 1925 Work

Number of towns scouted	25
Number of towns infested	5
Number of infestations found	20
Number of square feet of land burned over	926,730
Gallons of fuel oil used	11,267
Amount of money spent by State	$4,739.63

FURTHER NOTES ON THE ASIATIC BEETLE

Anomala orientalis Waterhouse

W. E. Britton and M. P. Zappe

This introduced insect pest has been discussed in preceding Reports of this Station as follows: 1922, page 345; 1923, page 91; 1924, page 294. Bulletin of Immediate Information, No. 52, issued December 15, 1925, and entitled "A New Pest of Lawns,"

Fig. 46.—Map of Westville showing the portion infested by the Asiatic beetle, surrounded by black line.

also deals with this insect, and brief notes were published in the Journal of Economic Entomology, Vol. 15, page 311, and Vol. 17, page 309.

During the first half of the summer of 1925, this insect seemed to cause little damage, and very few inquiries and complaints were received regarding it. At a brief talk in Washington, D. C.,

July 28, 1925, before the summer field meeting of the Northeastern Entomologists, the senior author made statements to this effect. In fact, at that time it seemed to him that the insect was not increasing, that the injury was no worse than in 1924, and that it had spread only slightly. But later in the season he felt like telling a different story. During August and September, many inquiries and reports of injury were received at the Station. In passing through the streets of the infested region, more injured lawns were noticeable than have ever been seen before since the presence of this pest was discovered in New Haven. Figure 46

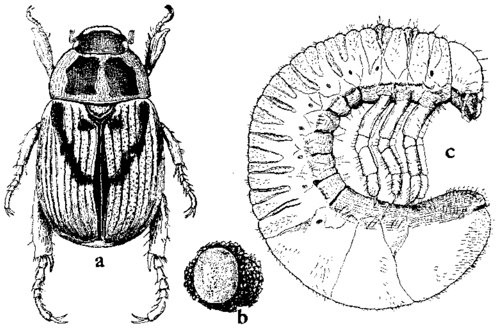

FIG. 47.—The Asiatic beetle, *Anomala orientalis*. a. adult beetle. b. egg. c. grub or larva. All enlarged about five times.

shows the area where the infestation occurs, and Figure 47 shows the appearance of the beetle, larva and egg. Plate XI, b, shows injury to lawns.

As the injury was more evident and the grubs more numerous than ever before, the matter was reported to the Federal Horticultural Board and the Bureau of Entomology, with a request that specialists be sent to review the situation. Consequently on October 29, 1925, Mr. Loren B. Smith in charge of Japanese beetle investigations, with Messrs. B. R. Leach and J. P. Johnson, all of Riverton, N. J., spent the day in New Haven, and with Director William L. Slate, Jr., and the writers, visited the infested area, observed conditions there, and conversed with residents and property owners. Mr. Smith expressed his opinion that the injury to lawns appeared more serious than similar injury in New Jersey

by the grubs of the Japanese beetle, *Popillia japonica*, which he had ever seen. Also Mr. Smith considered it not only unwise to allow this pest to continue to spread unchecked, but regarded it as a menace to the whole country. Especially if this insect should spread southward, he believed it might prove a very serious pest of various crops.

As a result of this visit, Mr. Smith submitted a report in which he advised an attempt to eradicate the pest by treating the entire area between Chapel Street and Willard Street, Yale Avenue and Forest Street, with carbon disulphide emulsion to kill the grubs. He recommended that the applications be made early next summer, perhaps in May, after the grubs resume feeding near the surface of the ground, and that it be a co-operative project between the Federal Government and the State of Connecticut.

At the time of Mr. Smith's visit, the grubs had descended into the soil for the winter, and consequently did not appear to be nearly as abundant as was the case a few weeks earlier. By digging, however, plenty of grubs were found, most of them being six to eight inches beneath the surface.

Tests and Observations Made in 1925

On April 16, the junior author examined some lawns near the corner of Edgewood and Alden Avenues by cutting out four-inch circles of turf with a sod cutter such as is used on golf greens. Several grubs were found, averaging about one to each circle of turf. Probably most of them had not come up from their winter evel in the soil, for an examination later in the season showed he same lawn to have a population of about 40 grubs per square oot.

We still believe that *Anomala orientalis* has an annual generaon, though it is evident that some of the grubs do not become nature at the usual time, but continue over into the second season.

Lawns which had been treated with cyanide and reseeded in 924 were examined on April 16. Some grubs were found here, hough the lawns presented a good appearance and no injury was pparent.

On September 25, one square yard of lawn was treated with ight ounces or one-half pound of granular calcium cyanide disolved in two gallons of water, sprinkled over the surface and ashed into the soil with eight gallons of clear water. Five grubs n a wire cage had been buried about two inches deep prior to the reatment. When examined September 30, all grubs were dead ut the grass had been injured.

Another section of the same lawn was treated on the same day sing calcium cyanide at the rate of four ounces per square yard, r half the amount mentioned above. On September 30, two

square yards were dug up and the grubs counted. One had 39, and the other 44, dead grubs and no living ones were found.

An infested lawn at 39 Elmwood Road was treated with six ounces per square yard of calcium cyanide, late in September. When examined, 24 hours after treatment, there were some living grubs, but several days later, on September 30, all grubs had been killed. This lawn had been spaded prior to treatment and grubs were in the bits of sod that had been turned several inches below the surface.

On October 3, 60 square yards of lawn at 50 Marvel Road were treated with calcium cyanide at the rate of four ounces per square yard. When examined on October 13, no living grubs could be found but the grass had all been killed.

On October 19, four tests were made on grubs in soil buried in cages, with a finer grade of calcium cyanide known as "grade G" or "Cyanogas," using it at the rate of one, two, three and four ounces respectively, per square yard. When examined on October 31, all grubs had been killed and in each case there was slight injury to the grass. Grade G has the same analysis as the granular calcium cyanide but is considerably finer.

Two tests were made with home-made carbon disulphide emulsion; one of 28 square yards, using two fluid ounces per square yard, and the other of eight square yards, using four fluid ounces per square yard. Both applications were made on September 30, and well watered immediately afterward. When examined on October 3, only 2.6 per cent. in the former case and 15 per cent. in the latter case had been killed by the treatment. Emulsions made in this manner are not effective killing agents, but in New Jersey several formulas have been developed which are effective in killing the grubs of the Japanese beetles. One of these provides for emulsifying carbon disulphide with a water-soluble, resin-fish-oil soap, which is said to surround the globules of carbon disulphide and to hold the fumes so that they are given off more slowly and thus act throughout a longer period of time.

At the writing of this paper, plans are under way for carrying out the recommendations of Mr. Smith's report, and the treatment of the infested area, but the funds are not yet assured.

TOBACCO PLANTS SEVERELY INJURED BY WIREWORMS

Mention has already been made on page 227 of severe injury to newly-set tobacco plants in Windsor and other towns in the tobacco growing section of Hartford County. The matter was reported to this office by Dr. P. J. Anderson in charge of the Tobacco Sub-station at Windsor, and Dr. Garman and the writer visited one of the fields on June 2. Most of the damage occurred

to tobacco plants under cloth, but Dr. Anderson reports some wireworm injury to plants in open fields.

One grower had 84 acres under cloth, and on about 40 acres the plants were destroyed and reset. The plants of the second setting were also ruined and the ground set again, and a portion of the third setting had also been destroyed when the writer visited the field on June 2. Many wireworms were collected, 18 being taken around one plant. Adult Elaterid beetles were common, resting upon the cloth both inside and outside the tents. Both wireworms and beetles were identified as *Limonius agonus* Say. After a few days of the extreme heat of the first week in June, the wireworms disappeared so that on June 5, when a second visit was made, it was difficult to find them. Probably they went deeper into the ground to escape the heat, and a few were obtained several inches below the surface. The field was again planted and no further injury resulted.

In some of the fields, about 95 per cent. of the plants were dead when the writer first saw them, and Plate XII, b, shows a view taken at that time. The stems were completely riddled with tunnels, as shown on Plate XII, a.

Mr. B. H. Walden, Assistant Entomologist, identified the wireworms, by comparison with other material, as *Limonius agonus* Say, and this identification was afterwards confirmed by Mr. J. A. Hyslop of the Bureau of Entomology. Specimens of the adult click beetles found resting on the cloth of the tent were also sent to Mr. Hyslop, who reported that these were also *Limonius agonus*, and the adults of the destructive wireworms. The appearance of both adults and larvae is shown in Figure 48. This is not the first record of wireworm injury to tobacco by this species in Connecticut. Our collection contains material from Hockanum in stems of tobacco, June 1, 1920. Mr. Hyslop visited East Windsor Hill, where similar though less extensive injury took place. Mr. Hyslop calls *Limonius agonus* the eastern field wireworm, and it is perhaps the most common species attacking tobacco in Connecticut. It is not the only species, however, as we have material in the Station collection from tobacco and identified by Mr. Hyslop bearing the following records: *Asaphes* sp., Portland, June 12, 1906, B. H. Walden; *Melanotus* sp., Poquonock, May 28, Windsor, May 29, 1921, E. H. Jenkins.

It is quite probable that the wireworms descended into the ground on account of the extreme heat during the first week in June, but that they were able to feed upon the roots of the large plants later in the season, and possibly upon the old sprouting stumps after the tobacco crop had been harvested. Dr. Anderson observed some wireworms near the bottom of the furrows where one of the fields was being plowed late in the fall. Very little is known exactly about the life history of *Limonius agonus*, but some species require two years and others six years for the complete

life cycle. Probably the period required for the complete development of the eastern field wireworm falls somewhere between these limits. All wireworms are the larvae of click beetles of the family Elateridae, of which nearly 100 species occur in Connecticut.

On June 2, some tests were made with carbon disulphide emulsion applied with the tobacco setter when plants were being reset. Two different proportions were used: (1) one part of carbon disulphide in 360 parts of water, and (2) one part of carbon disulphide in 720 parts of water. Three days later (June 5), when we visited the plantation, it was found that the first or stronger mixture had killed nearly all of the plants, and the second or weaker had not killed the wireworms.

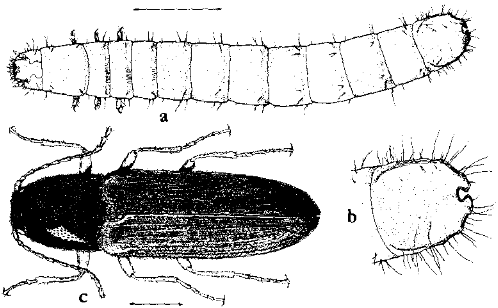

FIG. 48.—The Eastern Field Wireworm, *Limonius agonus*, a. larva; b. posterior segment of larva; c. adult beetle. All enlarged. Natural length of larva and adult indicated by the lines.

Tests were also made with calcium cyanide, which seemed to l effective in killing the wireworms, but also injured the plant In California the bean crop is often severely injured by wir worms, and the growers now forestall injury by planting eve fourth or fifth row with split seed which will germinate but n make strong plants. The wireworms are attracted to these we plants and then calcium cyanide is drilled in along each row ai kills both wireworms and plants. After waiting a few days, t crop can be planted without further injury.

Plans have been made for conducting further experiments ne season, and it is hoped that we may be able to obtain some defin data regarding wireworm control.

MOSQUITO CONTROL WORK IN CONNECTICUT

Season of 1925

R. C. Botsford

There are about 40 different species of mosquitoes in Connecticut, but for convenience in practical control work, the most important of these are included in four general groups, as follows: salt marsh, fresh water swamp, malaria, and rain barrel.

Mosquito control work in Connecticut as carried on by the Connecticut Agricultural Experiment Station is confined largely to the eradication of mosquito breeding places on the salt marshes. The salt marsh mosquitoes are considered the greatest nuisance. They breed periodically from April to October in certain depressions in the salt marshes. Their breeding areas occur near large centers of population and almost surround the cottages and summer homes which line our shores, and in addition they are known to fly five or 10 miles and infest areas where no breeding occurs.

Every intelligent person knows that mosquitoes can breed, or develop, through the egg, larval and pupal stages, only in still or stagnant water. This means that if there were no stagnant water, there would be no mosquitoes. Standing water on a salt marsh which tends to breed mosquitoes is removed through a simple system of ditches. These ditches are usually 24 inches deep, about 150 feet apart, and as wide as necessary to carry off the volume of water deposited on the salt marsh at high tide or by heavy rains. Fresh water swamps may be drained by a similar system of ditches, or if an outlet is impracticable, the surface water may be made to accumulate in a deep artificial pool stocked with larva-eating minnows. Receptacles holding water should be emptied once each week or, if in use, should be screened to prevent the adult mosquito from depositing its eggs upon the surface of the water.

Oiling or treating the water chemically are but temporary measures and are recommended only where drainage or fish control are impossible.

Unditched salt marshes which in some cases averaged as high as 80 per cent mosquito-breeding surface are now, since being ditched, practically free from breeding places and will remain so as long as the ditches function properly. It is just as important that the ditches be inspected regularly and kept open as to have the original ditching done; because clogged ditches will hold water and may breed mosquitoes in addition to all other depressions nearby, and the marsh would soon revert to its original condition and become a serious breeding place. Ditches should be inspected about once each month and stoppages removed. (See Plate XIV.)

There are over 5,000 acres of ditched salt marshes in Connecticut patrolled regularly throughout the mosquito breeding season under the supervision of the Connecticut Agricultural Experiment Station. Not only are ditches cleared and recondi-

tioned, but tide-gates, dikes, culverts, etc., are kept in repair as far as funds will permit.

STATUS OF CONNECTICUT SALT MARSH AREAS, 1925.

Town	Salt Marsh Acres	Salt Marsh Ditched	Maintained by State	Total Cost of Ditching	Labor, Cost of Maintenance 1925	Labor, Cost to Complete
Greenwich			None			
Stamford	300	300	200	$2,800.00	$177.20	
Darien	300	300	None	3,800.00		
Norwalk	600	600	None	7,500.00		
Westport	350	50	50	Ditched with Fairfield		$5,500.00
Fairfield	1,200	1,200	1,200	8,400.00	971.50	
Bridgeport	173					3,000.00
Stratford	1,315					20,000.00
Milford	630					9,500.00
West Haven	463	222	222	Ditched with New Haven	52.00	3,500.00
New Haven	750	750	750	12,000.00	528.00	
Hamden / No. Haven	2,042					30,000.00
East Haven	482	150	50	Ditched with New Haven	44.00	6,500.00
Branford	895	578	578	20,000.00 (Branford, Guilford, Madison)	832.50	4,800.00
Guilford	1,085	1,085	1,085		1,140.68	
Madison	1,005	1,005	1,005		986.17	
Clinton	766					12,000.0
Westbrook	500	170	None	2,746.07	4.00	4,754.0
Old Saybrook	1,373	60	None			20,000.0
Lyme	493					7,500.0
Old Lyme	1,393					21,000.0
East Lyme	424					6,500.0
Waterford	204					3,500.
New London	34					500.
Groton	304	50	50	1,000.00	8.00	4,000.
Stonington	555					8,500.
	17,636	6,520	5,190	$58,246.07	$4,744.05	$171,054.

According to old Government figures, there are about 22,0 acres of salt marsh in Connecticut. This figure, we belie includes the grassy areas completely covered by normal high tid which cannot breed mosquitoes. The mosquito-breeding areas a further reduced by fills, especially near large cities. For practi purposes we presume there are 18,000 acres of ditched a unditched salt marshes in Connecticut. In some instances mosq toes migrate from unditched areas and infest communities wh local control may be perfect. The remaining 13,000 acres of s marsh should be ditched to make control work most effective. T cost of ditching has increased about 100 per cent. since 19 The cost of maintenance, when extensive repairs are not inclu averages about one dollar per acre.

Although salt marsh work claims most of our attention, we have some requests to investigate communities where fresh water species are troublesome. The fresh water species have a much shorter flight range from their breeding place than the salt water mosquitoes, and where they are troublesome, they are generally found breeding on the infested premises or within a few hundred yards.

The officers of the Boy Scouts of Meriden made arrangements with the local health officer to carry on some anti-mosquito work this summer in the City of Meriden. A careful survey of the possible breeding places was made, and maps prepared by the Scouts. It was rather late in the season (June 10) to expect great relief, but in sections where the swamps and pools were systematically oiled, a reduction in the number of mosquitoes was reported.

The town of Clinton voted $10,000 to ditch the salt marshes of the town for mosquito elimination.

Mosquito control is a vital factor in the progress and development of this State, and more State funds should be provided in order that the work may be completed and past expenditures made more effective.

The table on page 316 shows approximately the present condition of the salt marsh areas in Connecticut.

THE WORK BY TOWNS

New Haven

In spite of the wet season, there was less mosquito *breeding* in the New Haven salt marshes this year than the two previous years. This was due to the progress made in recutting and grading damaged ditches.

However, New Haven was badly infested with salt marsh mosquitoes this summer, especially in the Prospect Hill section. The salt marsh nearest this part of the city is the great Quinnipiac River marsh of over 2,000 acres. The greater area of this marsh lies above the New Haven line and is unditched and contains breeding places. Prolific breeding has also occurred this summer in certain salt marshes of East Haven and West Haven.

The large marsh area near Morris Cove was ditched in 1912 for mosquito elimination. This area was never accepted by the State for maintenance, and now only traces of ditches remain. It is doubtful, however, if this is a breeding place of the salt marsh or migrating mosquito such as infests the city each summer, because an excellent tide-gate on Morris Creek seals this area against entry of ocean water. It is probable that all native species of fresh water mosquitoes, including the malaria mosquito, breed in this swampy area and torment local residents. Mosquito breeding in this section would be much lessened if Morris Creek were

dredged to the East Haven line at Dodge Avenue. Present insanitary conditions would be removed and property values tend to increase.

New Haven will have salt marsh mosquitoes so long as its neighboring towns remain unditched.

West Haven

Due to lack of State funds necessary to improve the outlet of Old Field Creek at Beach Street, immense broods of mosquitoes emerged from the Old Field Creek marsh this summer.

On June 6, 1925, Dr. Charles D. Phelps was appointed local Deputy in Charge of mosquito elimination. Through his efforts, enough local funds were made available to keep the outlet of Old Field Creek open the latter part of the season.

The key to the principal mosquito control problem in West Haven is the outlet of Old Field Creek at Beach Street. Our recommendations made in 1923 and 1924 offer a practical solution and are quoted: (1923) "The outlet from the gate to the harbor should be deepened about two feet and a sluiceway (pipe) installed to extend beyond the sand bar. A new tide-gate is required (on pipe) and the creek should be dredged from Beach Street to Peck Avenue," and (1924) "A sluiceway (pipe) with tide-gate should be installed in the outlet of the Old Field Creek, extending from Beach Street about 300 feet into the bay, and the creek dredged from Beach Street to Peck Avenue." After this is done it will be possible to clean out the ditches and keep them in good condition.

East Haven

The small salt marsh areas at Morris Creek and Caroline Creek under State care were practically free from mosquito breeding places the entire season. The other salt marsh areas in this town need more ditches in order to remove stagnant water from the marsh surface.

Mosquitoes of the fresh water species were very abundant and troublesome this year. The margins of Tuttle's Brook and the large swamps near the railroad track furnish typical breeding places. The presence of rain barrel mosquitoes indicated back-yard breeding places, such as barrels, tubs, pails, tin cans or other articles which may hold water.

Branford

The salt marsh of Stony Creek is in bad condition due to a leak under the foundation of the dike. Some temporary repairs were made, but it is planned to make permanent repairs on this dike this winter. The other salt marshes which were ditched for mosquito

elimination were patrolled throughout the season and the ditches kept open.

Mosquitoes were reported as being troublesome in certain localities and an investigation of the unditched salt marshes west of the Branford River revealed many breeding pools capable of supplying the town with mosquitoes.

Local interest in Pine Orchard and Indian Neck kept those communities free from fresh water species in spite of the frequent showers, which tend to keep fresh water swamps and hidden receptacles supplied with water.

The tide-gates on the Branford River were kept in fair service by constant patching. It is doubtful if these gates can be made to go through next season. A bid has been received for the complete reconstruction of these gates, but no money is available to carry on the work.

Conditions around Waverly Grove may be improved by a tile outlet near Lounsbury's Store.

Guilford

Extensive repairs were begun in September, recutting and grading ditches in the salt marshes of this town. It is planned to have all ditches open before next season.

Storm damage to the dike at Great Harbor is being repaired by the property owners.

Madison

The Town of Madison voted $200.00 for mosquito control work. This will be added to the regular State allotment for the town and will allow some much needed work to be done.

Iron culverts installed in the beaches functioned perfectly throughout the season. This resulted in much improved drainage which facilitated repair work on the ditches.

The State Park and Forest Commission has made available a limited amount of funds for anti-mosquito work in Hammonassett Park.

Westbrook

Another $1,000.00 was appropriated by the town to carry on their anti-mosquito program, and the work of ditching continued as usual.

Salt marshes near the center of the town and eastward to the Saybrook line have been ditched and are practically mosquito proof. Mosquitoes which were reported troublesome did not come from the ditched marshes. Breeding was heavy in the unditched marshes bordering the Patchog and Menunketesuck Rivers. Ditching of these marshes began this fall. (Plates XV and XVI.)

Groton

Ditches in this area were cleaned. recut and graded as required.

Fairfield

In the Town of Fairfield. $2,899.52 was expended for the maintenance and extension of fresh water drainage work. The bulk of this sum was furnished by popular town vote, the Fairfield Improvement Association and the Health Department each adding a good share. This sum does not include what the State regularly supplies.

The inspection work through the season was much handicapped by the continued ill health of Nicholas Matiuck. All infestations reported were investigated and breeding places destroyed. Most of the breeding places found were the result of recent construction work.

Stamford

The City of Stamford added $300.00 to the State funds for inspection and maintenance work. The work was carried on by experienced labor from Fairfield.

Following is a copy of an order and notice such as may be mailed to the land owners prior to ditching or otherwise treating such land for mosquito elimination:

Order and Notice Concerning Elimination of Mosquito Breeding Places in the Town of ———.

Whereas, by the provisions of Chapter 68 of the Public Acts of 1923, the Director of the Connecticut Agricultural Experiment Station may make rules and orders concerning the elimination of mosquitoes and mosquito breeding places, and he or his agent may enter upon any swamp, marsh or land to ascertain if mosquitoes breed thereon or to survey, drain, fill or otherwise treat, or make any excavation or structure necessary to eliminate mosquito breeding on, such land or cause same to be done, and

Whereas, sufficient funds have been raised to so eliminate mosquito breeding places within the areas hereinafter mentioned and described,

Now Therefore, I, William L. Slate, Jr., Director of the Connecticut Agricultural Experiment Station, by authority of said Chapter 68 of the Public Acts of 1923, hereby order that all mosquito breeding places be eliminated in the following areas in the Town of .... in the County of ...., State of Connecticut, to wit: (Here follows a description of the areas and method to be used.)

Map showing these areas is on file in the office of the Town Clerk of the Town of ....

Said elimination shall be by the ditching of all marsh areas within the above mentioned territory where either storm water or tide water does or may stand for several days. Ditches to be near enough together and deep enough to drain all such areas effectively, and main ditches, and natural waterways made as required to carry the drainage. Tide gates, dikes and other structures shall be made, if necessary, and artificial outlets constructed where natural outlets may not be made effective.

All said work shall be under the supervision of and subject to the approval of the Director of the Connecticut Agricultural Experiment Station.

Dated at New Haven, Connecticut, ...

WILLIAM L. SLATE, JR., *Director.*
Connecticut Agricultural Experiment Station.

MISCELLANEOUS INSECT NOTES

A Scale Insect New to Connecticut: During the summer of 1925, the writer discovered a white scale of the genus *Eriococcus* on some shrubs of *Spiraea salicifolia* growing on his home grounds. Specimens were identified by Mr. Harold Morrison of the Bureau of Entomology as *Eriococcus borealis* Cockerell (shown on Plate XVII, b.), a species not before recognized as occurring in Connecticut.

Birch Twig Gall: On July 18, 1924, the writer observed a peculiar swelling at the base of a twig on paper or canoe birch, that resembled the swellings or galls caused by certain species of *Agrilus*. The twig was removed from the tree and placed in a cage in the insectary. On April 24, 1925, an adult beetle of *Neoclytus acuminatus* Fabr., emerged.

Lace-Bugs Injuring Elm Foliage: On August 27, Mr. W. O. Filley brought to the office some elm leaves from Canaan, which had the under sides covered with excrement and cast skins. On September 4, Mr. Filley brought similar material from West Cornwall. Both lots of leaves had been attacked by the elm lace-bug, *Corythucha ulmi* Osborn and Drake, and some adults were present. This species, first described from Ohio in 1916, was received on elm from Litchfield in 1922.

Conservatory or Asiatic Camel Cricket in Connecticut: On December 17, a specimen from a greenhouse in Southport was handed me for identification. Mr. Walden found it to be the conservatory or Asiatic camel cricket, *Diestrammena japonica* Blatchley (*marmorata* DeHaan), an Oriental species which has been reported from Minnesota, Wisconsin, Kansas, Illinois, Ohio, Canada, Maine, Massachusetts and Rhode Island, usually occurring in cellars or greenhouses. This is the first record for Connecticut and it is not known whether this cricket injured the plants. If so, some means of control must be devised.

Borer in Willow Twigs: On August 20, while inspecting nurseries in Durham, Mr. Zappe found some yellow bark willows

with borers at work in the shoots some distance back from the tips, and where the shoots were about the size of one's finger. He gathered material and brought to the insectary, and on August 26 two adults emerged and on August 30 another adult appeared in the cage. These specimens seem to be identical with those of *Janus abbreviatus* Say, in the Station collection, and also run to it in the key to the species of *Janus* in the Hymenoptera of Connecticut.

Abundance of Cherry and Pear Slug: The cherry and pear slug, *Caliroa cerasi* Linn., has often been noticed feeding upon the leaves of small pear and cherry trees in nurseries or young orchards, but seldom does it attack and injure large trees. When inspecting nurseries, Mr. Zappe observed an old and large sweet cherry tree in Cromwell which was perhaps 35 feet tall and the foliage had been skeletonized and was brown from the feeding of the larvae. Particularly the top and the south side of the tree showed this condition. On the north side, the lower branches were somewhat greener. Mr. F. A. Bartlett reported to the writer that late in the season he had also seen large trees in Fairfield County with foliage brown from the attacks of this insect.

Abundance of Grasshoppers: Grasshoppers were very abundant in certain localities. Reports were received from Woodbridge and Guilford, and a visit was made to Guilford, August 15, where the second crop of grass had been cut. Grasshoppers were plentiful and rose in swarms from the grass, when the mowing machine passed through the field. Nearly all stages were present. A few mature specimens were collected and Mr. Walden identified them as the red legged grasshopper, *Melanoplus femur-rubrum* DeGeer. Another nearby farm had a 10-acre field of alfalfa which, according to report, had been nearly ruined by grasshoppers. Poisoned bait of bran mash scattered about the field is perhaps the best remedy and is used very extensively in some of the western states.

European Pine Mite in Connecticut: On November 12, 1924, in compliance with a request, the writer examined some conifers growing close to the front porch of the residence of Mr. Clarence L. Beardsley, 244 McKinley Avenue, New Haven. Some of these conifers had been attacked by mites and the leaves were light colored. Two Scotch pines had peculiar bunchy or "witches broom" growths at the upper terminals as shown on Plate XVII, a. Some of these growths were removed and taken to the laboratory, where they were examined by Dr. Garman. He found mites in them which he identified as the European pine mite, *Eriophyes pini* Nal., a species which at that time had not been reported as occurring in the United States. The record was overlooked and

therefore was not published. Recently this mite has been reported by Walther* as injuring pine trees on the Pacific Coast. Spraying with a miscible oil, one part in ten parts of water, has given promising results in California, but further investigations are needed before we can recommend any treatment for Connecticut.

Sawfly Larvae Feeding upon Rudbeckia "Golden Glow": In the Report of this Station for 1924, page 342, was published a note regarding sawfly larvae found feeding upon "golden glow" in Westport, and illustrations were shown on Plate XXXVI.

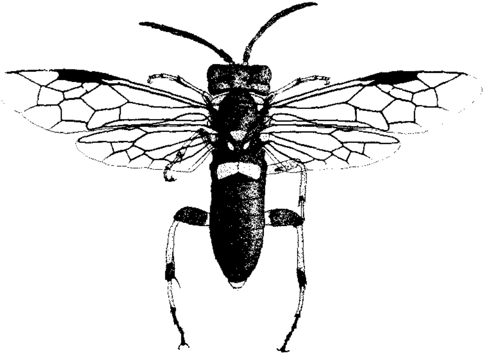

FIG. 49.—Adult Sawfly, *Macrophya simillima.* Enlarged about six times.

Mention was made of an adult sawfly of the species *Tomostethus inhabilis* Norton, which had been reared from the material, though probably occurring there accidentally. On May 26 and June 7, 1925, some much larger sawflies emerged from the soil in the same cage, and were identified by Mr. S. A. Rohwer of the U. S. National Museum as *Macrophya simillima* Rohwer. On May 25, Mr. Friend collected several specimens of the same species on the bed of "golden glow" at Westport, and on June 20, Mr. Friend and the writer collected many larvae there, and brought back plants upon which to feed them. Heretofore the food plant and

*Journal of Economic Entomology, Vol. 18, page 830, December, 1925.

habits of the species were unknown. It is also a species not before recorded as occurring in Connecticut. The original description was published in Entomological News, Vol. 28, page 265, 1917, and was drawn from material collected in St. Louis, Mo., and Lincoln, Nebraska. There is no doubt about this species being responsible for stripping the plants of "golden glow." The adult sawfly is shown in Figure 49, and the egg-blister on Plate XIX, b.

Noctuid Larvae Injuring Young Apple Trees: On May 6, Mr. Zappe brought to the insectary some Noctuid larvae found in a nursery in Durham, which has caused much injury to young apple trees by eating off the buds which had been set in the stocks the preceding summer, as shown on Plate XVIII, b. The larvae were plentiful on the ground. On May 12, larvae were scarce, but much injury was evident. Not only had the buds been eaten, but the bark had also been entirely eaten from some of the stocks. The lower leaves of nearby raspberry plants had also been eaten, leaving only the mid-ribs, as shown on Plate XVIII, a. Leaves 12 inches or more above the ground were uninjured. Only nine larvae could be found on May 12, and these were beneath the surface of the soil under newly-injured plants. As there seemed to be two different species of larvae, they were placed in separate rearing cages, and on June 15 adult moths of both species emerged. They proved to be *Agrotis unicolor* Walker (formerly known as *Noctua clandestina* Harris) and *Noctua fennica* Tausch., both species being shown on Plate XVIII, c, and d. One Tachinid parasite emerged from the latter June 7, and has been identified as *Phorocera claripennis* Macq., by Dr. J. M. Aldrich of the U. S. National Museum.

Pears Injured by Quince Curculio: During late August and September, Seckel pears in the writer's home garden dropped heavily before ripening, and usually on one side of each fruit there was a hard flattened area with indication of insect punctures. On cutting open the fruit, small legless grubs were found in cavities between the skin and the core. An examination of these grubs showed them to be curculio larvae. Messrs. Zappe and Stoddard made a trip into eastern New York State during June, and after their return reported much damage to pears during the preceding year from the attacks of the quince curculio, *Conotrachelus crataegi* Walsh. On December 17, 1925, Professor P. J. Parrott, Entomologist of the New York Experiment Station at Geneva, N. Y., gave an address before the Connecticut Pomological Society at Hartford, and from photographs of the injury, he identified it as the work of the quince curculio. Material was gathered and placed in cages in the insectary, but the adults have not yet been reared; they are not expected to emerge until May or June. There is

one generation each season and the grub on leaving the fruit goes into the soil and remains there through the winter. The grub and the appearance of injured fruit is shown on Plate XX, b, and c, of this Report.

The Rose Stem Girdler in Connecticut: On September 8, stems of *Rosa rugosa* were received from Darien, having the peculiar characteristic swellings or galls caused by the rose girdler, *Agrilus viridus*, var. *fagi* Ratz. These stems are shown on Plate XIX, a. On October 14, stems of *Rose hugonis* with similar swellings or galls were received from Norwalk, adjoining Darien. Though no adults have been reared from these stems, the injury so closely resembles that described and figured by Weiss* as occurring in New Jersey, that we have no hesitancy in ascribing it, at least tentatively, to that species. which occurs in Europe and has been recently recorded from New Jersey. The swelling is elongate, and the stem diameter increased sometimes only slightly and in other cases nearly doubled. Sometimes the stem is swollen and enlarged at several places. The adult is said to be a small metallic coppery beetle, about one-third of an inch long, which lays eggs singly on the bark in June and July. The young larva enters the sapwood and makes a series of spiral tunnels close together around the stem for a distance from one to two and one-half inches. The larval period is said to extend over a period of two years and pupation takes place in a cell in the stem from three to six inches above the swelling. Not only does this beetle injure rose, but it is known to attack birch, beech, alder, oak and poplar. The only known remedy is to cut and burn the infested stems in winter or spring before the beetles emerge.

Tobacco Injured by Tipulid Larvae: On June 5, the writer visited a large tent tobacco plantation in Windsor, where some maggot injury (probably seed-corn maggot, *Hylemyia cilicrura* Rond.) had been reported. Many injured plants were found, but no white maggots, though the foreman said that he had found some of them this season. Many of the plants had been injured near the surface of the ground, and the injury was somewhat larger than is usually caused by the seed-corn maggot, as well as being higher up on the side of the stem. There were many "leather jackets" or cranefly (Tipulid) larvae in the surface layer of the soil and we wondered whether or not they were responsible for the injury. A number of empty pupa cases were found protruding from the surface of the ground. Many larvae were collected and brought to the laboratory, and larvae and injured plants

* New Jersey State Department of Agriculture, Bureau of Statistics and Inspection, Circular No. 36, page 9, 1921; Circular No. 48, page 13, 1922.

were photographed. These larvae were placed in a cage outside the insectary and some uninjured plants set in the cage with the larvae, the surface of the soil being kept at the ground level. On June 8, two plants in the cage showed the same form of injury as those collected in the field. On September 9, one adult fly emerged. Adult, larva and injured plant are shown on Plate XIII. This was identified as *Nephrotoma ferruginea* Fabr., by Professor C. P. Alexander of Amherst, Mass. Two or three adults found resting on the tent June 5 proved to be the same species. Apparently this is one of the first records, if not the first, of Tipulid injury to young tobacco plants. According to the Insect Pest Survey Bulletin, Dr. H. T. Fernald observed similar injury to tobacco plants in Hadley, Mass., in June 1925, which he attributed to cranefly larvae.

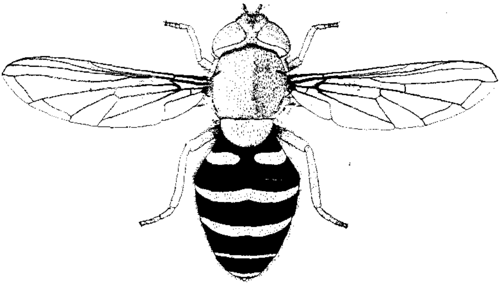

FIG. 50.—Adult Syrphid Fly, *Syrphus torvus*. Enlarged about five times.

Syrphid Eggs and Larvae on Apple: While engaged upon some fruit survey work in the spring of 1925, Mr. E. M. Stoddard and the writer found the eggs of Syrphid flies quite common on the young unfolding apple leaves. (See Plate XIX, c.) They were particularly abundant near colonies of aphids. The eggs are laid singly but frequently two or three could be found on a single leaf. The larvae of these Syrphid flies feed upon aphids. They have often been seen before, but for several years the eggs have not been as abundant as in the spring of 1925. The eggs of this insect were found in the following towns: Wallingford, Wilton, Middlefield, Middletown, Litchfield, Newington, Cheshire, Southington, Washington, Milford, Vernon, Durham and Groton.

Many of the orchards where Syrphid eggs were found were visited again later in the season and aphids had apparently been held in check by this insect; in some cases there were hardly enough aphids to satisfy the appetites of the Syrphid larvae. It was not uncommon to find a twig which bore evidence that many aphids had been present, but had all disappeared, having been eaten by Syrphid larvae, which could be found on the nearby leaves. Frequently a larva could be found in a leaf which had been rolled by a colony of aphids, but the aphids had been nearly all eaten. On April 17, 1925, a number of Syrphid eggs were collected and placed in breeding cages with aphid infested twigs. The eggs hatched and all larvae were full grown by May 9, and began to pupate. Adults began to emerge from the pupae on May 22, and the last one emerged May 27. An examination of the adults proved them to be *Syrphus torvus* O. S., a species which in the larval or worm stage commonly feeds on aphids. The flies themselves do not feed on aphids, but are said to feed on the nectar of flowers. The adult flies look very much like small bees, and are often mistaken for them. This insect was also reared from larvae collected on peach leaves where they were found feeding on aphids. At Cheshire, Hamden and Southington, these larvae were reported to be doing splendid work in checking an outbreak of peach aphids, probably *Myzus persicae* Sulzer. The adult fly is shown in Figure 50.

M. P. ZAPPE.

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a. Infestation No. 5, Norfolk, 83 egg-clusters.

b. Infestation No. 3, Colebrook

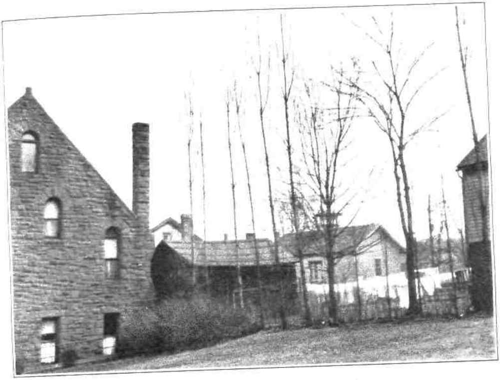
GIPSY MOTH INFESTATIONS.

PLATE II.

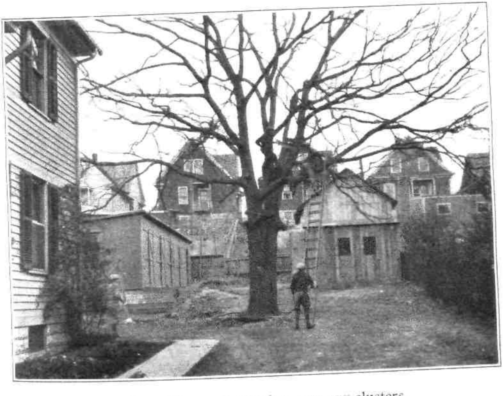
a. Infestation No. 1, East Granby, 8 egg-clusters on willows.

b. Infestation No. 2, North Canaan, 208 egg-clusters.

GIPSY MOTH INFESTATIONS.



a. Infestation in Meriden, 11 egg-clusters.

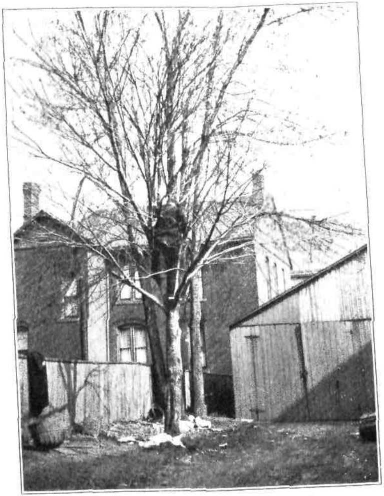


b. New Haven infestation, 120 egg-clusters.

GIPSY MOTH INFESTATIONS.

PLATE IV.

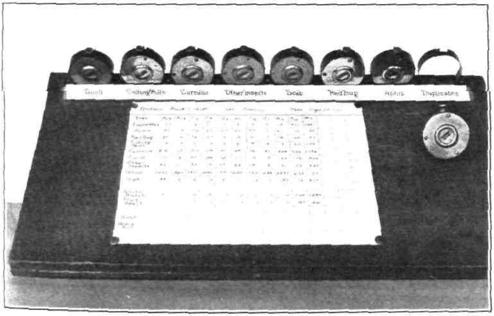
a. Spraying New Haven infestation.



b. Infestation No. 7, Hartford, 4 egg-clusters on maple and fence.

GIPSY MOTH WORK.

a. Gipsy moth parasite can containing *Anastatus bifasciatus.*



b. Battery of tally meters, with record sheet used in scoring fruit, much reduced.

GIPSY MOTH WORK AND FRUIT SCORING APPARATUS.

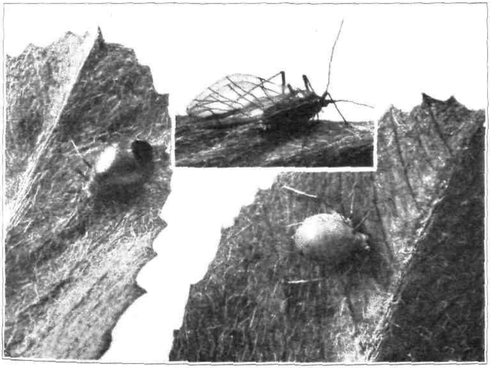
PLATE VI.

a. Outfit used in spraying peach trees, Conyer's farm, Greenwich.

b. Dusting outfit used at Conyer's farm, Greenwich.

ORIENTAL PEACH MOTH INVESTIGATIONS.

a. Alfalfa plants infested with aphids; two plants at left seriously injured. Somewhat reduced.

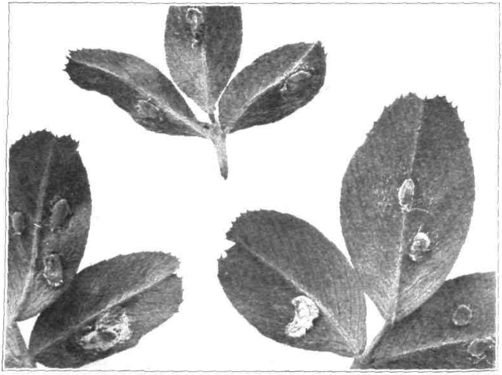


b. Wingless aphids killed by parasites, specimen at left showing exit hole of parasite; insert showing winged aphid killed by fungus. All enlarged six times.

PEA APHIDS ON ALFALFA.

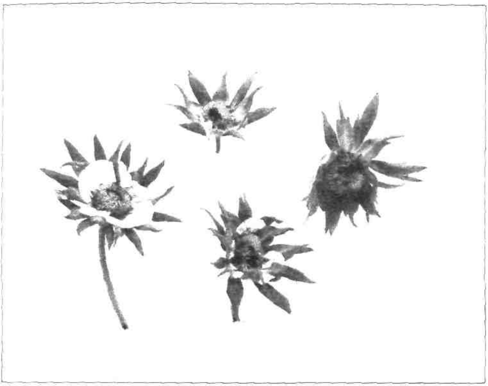
PLATE VIII.

a. Alfalfa shoot showing aphids killed by fungus. Somewhat reduced.

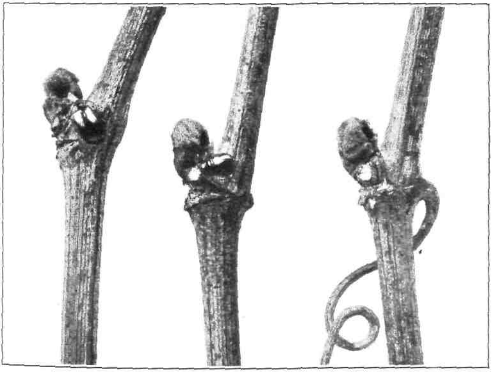


b. Alfalfa leaves showing aphids killed by fungus. Twice enlarged.

PEA APHIDS ON ALFALFA.



a. Strawberry blossoms, injured by adults of the raspberry fruit worm, natural size.



b. Grape vine buds injured by the grape vine flea beetle, *Altica chalybea*, twice enlarged.

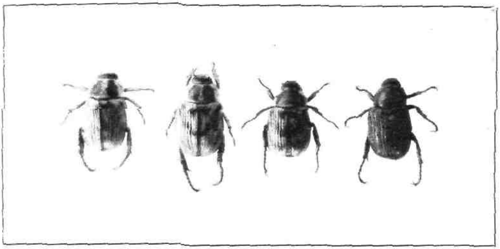
WORK OF RASPBERRY FRUIT WORM AND GRAPE VINE FLEA BEETLE.

PLATE X.

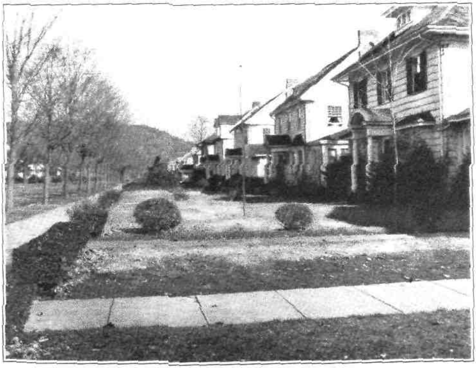
a. Weed area to be burned near infestation, Noank.

b. Burning cornstalks at infestation in Stonington.

EUROPEAN CORN BORER WORK.



a. Adults showing variation from light brown to black, twice natural size.

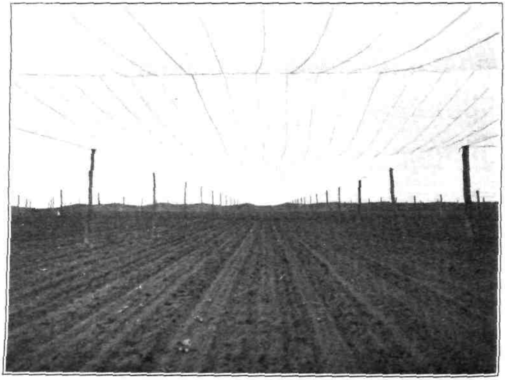


b. Lawn in Westville (New Haven); dark area shows grass killed by the grubs of the Asiatic Beetle.

ASIATIC BEETLE.

PLATE XII.

a. *Injury to young plants, natural size.*

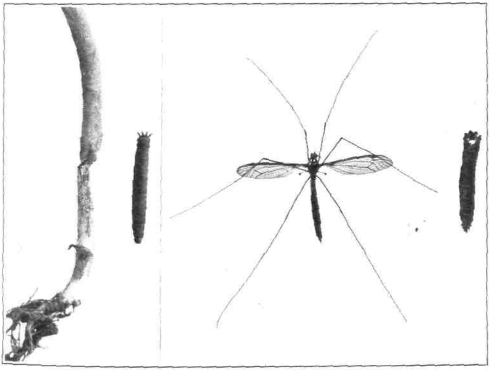


b. View in tobacco tent where nearly all of the plants have been destroyed by wireworms.

WIREWORM INJURY TO TOBACCO.

PLATE XIII.

a. Injury to plants. Natural size.



b. Adult, larva and pupa skin. Natural size.

CRANEFLY INJURY TO TOBACCO.

PLATE XIV.

a. A large breeding area caused by the deliberate closing of one ditch.

b. Mosquito breeding pool caused by dumping rubbish in *front of roadway culvert.*

MOSQUITO CONTROL WORK.

a. Sods piled to prevent floating.

b. Hand cut ditch in salt marsh.

MOSQUITO WORK, WESTBROOK.

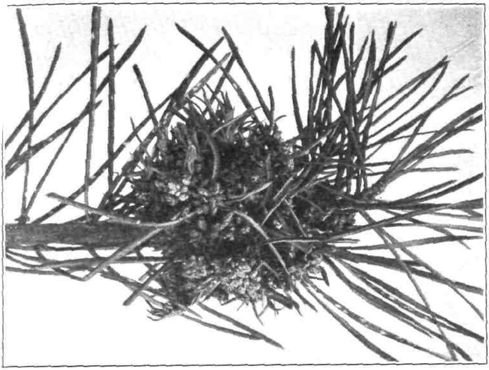
PLATE XVI.

a. Draining salt marsh breeding pool.

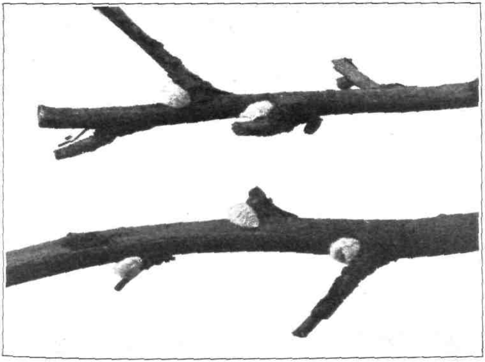
b. Guide board being placed in position for cutting ditch with hay knives.

MOSQUITO WORK, WESTBROOK.

PLATE XVII.



a. Gall of *Eriophyes pini* on Scotch pine, natural size.

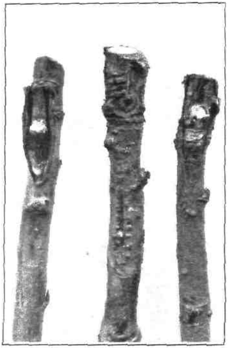


b. *Eriococcus borealis* on *Spiraea salicifolia*, twice enlarged.

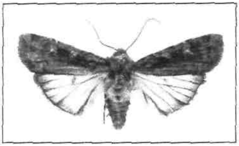
MITE AND SCALE INSECT NEW TO CONNECTICUT.

PLATE XVIII.

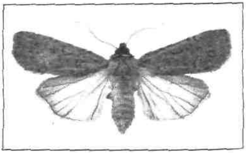
a. Raspberry plants stripped by Noctuid caterpillars.



b. Budded fruit trees, showing where buds were destroyed by Noctuid caterpillars, natural size.

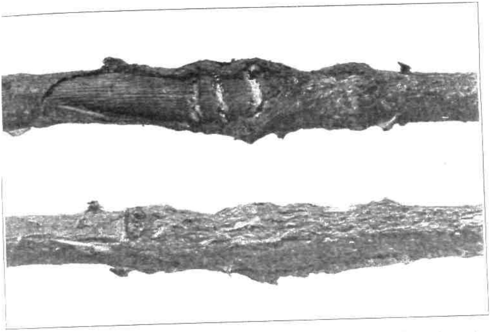


c. *Noctua fennica*, natural size.



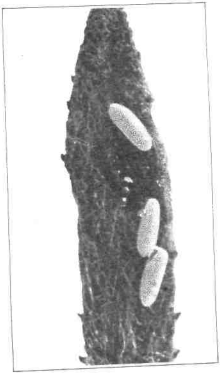
d. *Agrotis unicolor*, natural size.

INJURY CAUSED BY NOCTUID LARVAE.



a. Galls of rose stem girdler, *Agrilus viridus* var. *fagi*, twice enlarged.

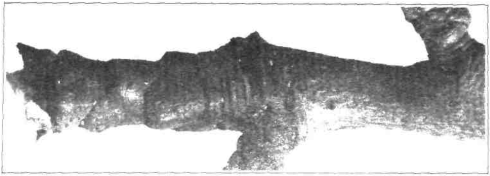
b. Leaf of "Golden Glow" showing on right an egg-blister of the sawfly, *Macrophya simillima*, twice enlarged.



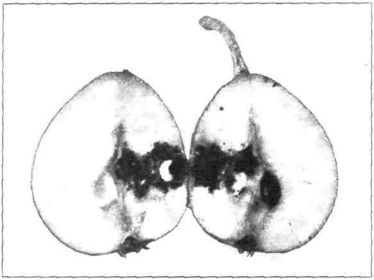
c. Eggs of *Syrphus torvus* on apple, enlarged ten times.

ROSE GALLS AND EGGS OF SAWFLY AND SYRPHID FLY.

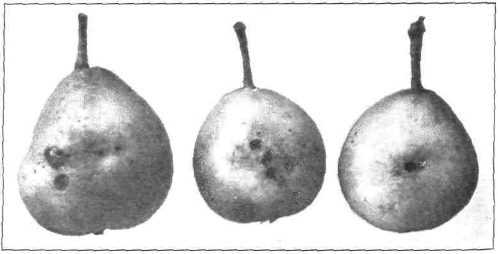
PLATE XX.



a. Eggs of pear psylla on twig, about twice enlarged.



b. Section of Seckel pear infested with quince curculio, showing grubs, natural size.



c. External view of Seckel pears infested with quince curculio; somewhat reduced.

PEAR PSYLLA AND QUINCE CURCULIO.

BULLETIN 276 MARCH, 1926

Connecticut Agricultural Experiment Station

New Haven, Connecticut

The Thirtieth Report on

FOOD PRODUCTS

and the Eighteenth Report on

DRUG PRODUCTS

1925

By

E. M. BAILEY

The Bulletins of this Station are mailed free to citizens of Connecticut who apply for them, and to other applicants as far as the editions permit.

CONNECTICUT AGRICULTURAL EXPERIMENT STATION

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March, 1926

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* Assigned by the U. S. Dept. of Agriculture.

THE TUTTLE, MOREHOUSE & TAYLOR COMPANY

CONTENTS AND SUMMARY.

Materials	Page	Sampled by, or at request of: Station Agent	Dairy and Food Commissioner	Individuals	Total	Adulterated, below standard, or otherwise illegal
FOODS						
Bread	335	...	...	8	8	...
Carbonated Beverages	336	...	23	...	23	...
Cacao Products	337	3	...	2	5	...
Coffee	337	22	...	...	22	...
"Diabetic," Special and Miscellaneous foods	340	36	6	...	42	...
Eggs	349	...	24	...	24	16
Fats and Oils:						
Butter	350	...	23	...	23	5
Oleomargarine	350	...	3	...	3	1
Lard	350	...	16	...	16	...
Flavoring Extracts:						
Vanilla	352	...	5	...	5	2
Lemon, etc.	352	...	38	...	38	4
Orange	353	...	7	...	7	...
Gelatin	358	7	...	...	7	...
Ice Cream	358	...	405	7	412	3
Meat Products:						
Hamburg Steak	359	...	14	...	14	3
Frankfurts	359	...	16	...	16	11
Bologna, etc.	360	...	3	...	3	3
Pork Sausage	360	...	25	...	25	6
Milk and Milk Products:						
Market Milk	360	...	522	131	653	216[1]
Condensed Milk	361	...	1	...	1	...
Evaporated Cream	361	...	1	...	1	...
Colostrum	363	30	...	...	30	...
Malted Milk	363	1	...	...	1	...
Human	364	...	...	2	2	...
Tea	364	5	...	...	5	...
Vinegar	364	2	2	13	17	2
Miscellaneous	364	...	...	5	5	...
Total		106	1134	168	1408	272

[1] Includes 162 below standard only.

CONTENTS AND SUMMARY—*Concluded.*

Materials	Page	Sampled by, or at request of: Station Agent	Dairy and Food Commissioner	Individuals	Total	Adulterated, below standard, or otherwise illegal
DRUGS.						
Tablets, Pills, etc.	365	...	15	...	15	1
Iodine, Tincture of	369	...	1	...	1	1
Lime Water	369	...	12	...	12	2
Peppermint, Essence of	369	...	9	...	9	2
Prescriptions:						
Potass. Iodide	370	...	56	...	56	14
Arsenous Acid, Soln.	371	...	22	...	22	12
Spirits Ammonia, Aromatic	372	...	43	...	43	25
Silver Preparations, Colloidal						
Argyrol Type	377	13	59	...	72	22
Protargol Type	378	3	17	...	20	5
Proprietary Remedies	383	4	...	...	4	...
Toilet Preparations	386	...	4	...	4	...
Turpentine	386	...	22	...	22	4
Miscellaneous, for Poisons, etc.	387	...	1	21	22	...
Total		20	261	21	302	88
Total, Foods and Drugs		126	1395	189	1710	360
Whiskey	389	...	...	...	...	...
Babcock Glassware, etc.	392	...	...	...	3826	4

The Thirtieth Report on Food Products and the Eighteenth on Drug Products

E. M. Bailey

This report summarizes the work done upon foods and drugs for the calendar year 1925 and includes a few samples of drugs taken in 1924 which could not be examined in time to be included in the report for that year.

As in past years, collaborative work for the Association of Official Agricultural Chemists has been done, the subjects this year being cacao products, vinegar and certain insecticides. The report on cacao products and analytical results on the other materials are reported elsewhere.[1] Coöperation has been continued also with the Council on Pharmacy and Chemistry of the American Medical Association in the examination of foods intended for diabetic dietaries; and the writer, as a member of the Joint Committee on Definitions and Standards, has attended the two meetings of that committee during the year.

Credit for the analytical work herein reported is due entirely to Messrs. Andrew, Shepard, Fisher, Nolan and Mathis. Miss Bacon has assisted materially in preparing this and other reports for publication.

I. FOODS.

Bread.

Eight samples of bread were examined for the County Commissioners of New Haven County, the samples being submitted by Deputy Jailer Baldwin. The breads were from four different bakeries and they were sampled at different times in two lots of four each, under as nearly the same conditions as possible. Analyses and other data obtained are given in Table I.

The loaves, particularly samples 2, 3 and 4, are very uniform in composition as shown by the results obtained at different intervals; and as regards the percentage amounts of food solids, and actual weights of food solids per loaf, the loaves are evaluated in the same order by each series of analyses. Caloric values are not very different, but loaf 3 derives a somewhat greater proportion of calories from protein and fat than the others.

We have no information as to the baking formulas of these products. If some of the breads are made with milk they will be superior to those not so made even though the caloric values are practically the same.

---

[1] *Jour. A. O. A. C. Report of the Proceedings for 1925.*

TABLE I. ANALYSES OF BREADS.

ampler's No.	No. 1 First	No. 1 Second	No. 2 First	No. 2 Second	No. 3 First	No. 3 Second	No. 4 First	No. 4 Seco
tation No.	**2865**	**3031**	**2866**	**3032**	**2867**	**3063**	**2868**	**303**
Vater	37.01%	38.16%	35.43%	35.78%	36.12%	36.69%	35.34%	34.(
sh	1.28	....	1.56	....	2.08	....	1.60	...
Protein (N x 6.25)	9.07	8.59	8.70	8.51	9.89	9.80	9.17	9.
iber	0.17	....	0.14	....	0.16	....	0.17	..
Carbohydrates other than fiber	51.71	....	51.99	....	49.29	....	51.45	..
Fat	0.76	....	2.18	....	2.46	....	2.27	..
Calories per 100 gms.	250.00	....	262.00	....	259.00	....	263.00	..
Solid food material	62.99	61.84	64.57	64.22	63.88	63.31	64.66	63.
Weight of loaf, ozs.	24.00	25.40	19.50	19.30	20.00	20.20	21.00	20.
Solid food material per loaf, ozs. ..	15.10	15.70	12.60	12.40	12.80	12.80	13.60	13

CARBONATED BEVERAGES.

Chapter 102, Public Acts of 1925, concerning the manufacture and bottling of beverages provides, among other things, that beverages other than cereal beverages, cider and spring or mineral water, shall have a sugar content of not less than 5 per cent by weight.

Twenty-three samples were submitted by the Dairy and Food Commissioner and the same examined for total solids, sugar and saccharin.

The occurrence of saccharin in this type of products is now very rare and in none of the samples examined was this artificial sweetener found. Sugars were determined by reduction methods before and after inversion, the sugar content being taken as the sum of invert sugar and sucrose. Varying but substantial increases in reduction after inversion were found in all cases. Sugar exceeded 5 per cent in all samples, the highest amount found being 15.7 per cent.

The results are given in Table II.

TABLE II. ANALYSES OF CARBONATED BEVERAGES.

No.	City or Town	Manufacturer	Solids %	Sugar %
26278	*Ansonia*	Crystal Bottling Works	9.42	8.91
26263	*Bristol*	C. E. Perkins Bottling Works	9.66	9.49
26269		Perkins Bottling Works	9.66	9.61
26271		Perkins Bottling Works	10.55	9.82
26270	*Canton Center*	O'Keefe's Beverages, Limited.	7.32	7.24
26273	*Hartford*	Bacon Bottling Works	10.82	10.26
26277		Bacon Bottling Works	10.27	9.71
26266	*New Haven*	Kene's Bottling Works	12.60	11.66
26274		Sweeney's Bottling Works ...	7.45	6.99
26251	*New London*	Nutmeg Bbttling Works	11.42	10.87
26256		Purity Bottling Works	12.51	12.87

TABLE II. ANALYSES OF CARBONATED BEVERAGES—*Concluded.*

No.	City or Town	Manufacturer	Solids %	Sugar %
26264	*Stamford*	Silver Spring Water Co.	9.52	9.29
26272	*Torrington*	Fox Bottling Works	10.78	10.89
26254	*Waterbury*	Brass City Bottling Works ..	16.45	15.65
26253		Brooklyn Bottling Co.	12.17	11.63
26276		Diamond Beverage Corp. ...	7.90	7.59
26255		Hamilton Bottling Works ...	13.96	12.47
26261		Puritan Ale Co.	7.87	7.61
26257		Mascola Bottling Works	12.16	11.52
26260		C. Mascola Bottling Works ..	10.65	10.16
26252		Reiner Bros.	10.23	10.72
26258		Riverside Bottling Co.	13.62	12.93
26275	*Westville*	West Rock Bottling Works ..	12.83	12.07

CACAO PRODUCTS.

Only two samples of this class of foods were examined. One was Cho-Lay, a product made by the Saville Chocolate Products Co., Pittsburgh, Pa. It contained 7.38 per cent of protein and 7.60 per cent of fat. A more complete analysis of this product was made by us last year.[1] The other was a sample of cocoa submitted by the Hartford Tuberculosis Society to be examined for fat content. The sample contained 15.35 per cent of fat.

In connection with a critical study of the present official and tentative methods of the Association of Official Agricultural Chemists for the analysis of cacao products, complete analyses of a sample of bitter chocolate, of sweet chocolate and of sweet milk chocolate were made by Messrs. Shepard and Mathis. Their results, together with those of other collaborators, will be published elsewhere.[2]

COFFEE, ETC.

Twenty samples of coffee, one of Kaffee Hag, and one coffee substitute were collected by the station agent.

According to the present standard, coffee should contain not less than 10 per cent of fat and not less than 3 per cent of ash. Kaffee Hag is modified coffee, the caffeine being practically eliminated. In other respects, so far as determined, it corresponds to the limits of composition as given for coffee. Sample 454 is a coffee substitute, so labelled, and contains about 50 per cent of pure coffee.

For the determination of caffeine in coffee the Fendler-Stüber is the optional official method. The optional official method for caffeine in tea appears, however, to be equally well adapted to coffee according to the results here reported.

Analysis are given in Table III.

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[1] Conn. Exp. Sta. Bull., 267, 428, 1924.

[2] Assoc. Off. Agr. Chemists, Proceedings, 1925.

TABLE III. ANALYSES OF COFFEE, ETC.

Station No.	Manufacturer or Dealer and Brand Name	Soluble Solids	Ash	Fat	Caffeine: Fendler-Stüber Method, Grav.	Caffeine: Fendler-Stüber Method, From N.	Caffeine: Bailey-Andrew Method, Grav.	Caffeine: Bailey-Andrew Method, From N.
	COFFEE.	%	%	%	%	%	%	%
442	Austin, Nichols & Co., Inc., N. Y. *Java and Mocha*	11.48	4.15	14.03	1.39	1.26	1.40	1.28
431	Austin, Nichols & Co., Inc., N. Y. *Sunbeam*	11.17	3.88	15.60	1.24	1.17	1.43	1.21
441	Baker Importing Co., N. Y. *Barrington Hall* Bakerized	11.00	4.15	15.58	1.29	1.21	1.27	1.18
433	Beech-Nut Packing Co., Canajoharie, N. Y. *Beech Nut*	11.50	4.38	14.83	1.42	1.33	1.42	1.34
440	The Wm. Boardman & Sons Co., Hartford. *Boardman's Gold Star*	11.43	4.38	12.10	1.63	1.36	1.58	1.37
411	Brownell & Field Co., Providence, R. I. *Autocrat*	11.10	4.03	14.00	1.25	1.15	1.32	1.18
457	Brown-Thompson & Co., Hartford	10.65	4.08	14.48	1.29	1.21	1.27	1.22
412	Cheek-Neal Coffee Co., N. Y. *Maxwell House* High Grade Coffee	11.48	4.23	14.95	1.37	1.19	1.33	1.19
443	Andrew Davey, Inc., N. Y. *Atlas*	11.18	3.98	14.53	1.37	1.29	1.34	1.28
409	Dwinnell-Wright Co., Boston. *White House*	11.55	4.08	15.10	1.40	1.17	1.37	1.19
424	B. Fischer & Co., Inc., N. Y. *Astor*	10.95	4.25	14.93	1.28	1.14	1.33	1.17
403	Hartford Market Co., Hartford	11.75	4.33	13.78	1.12	1.07	1.25	1.05
420	Francis H. Leggett & Co., N. Y. *Premier*	11.92	4.38	14.70	1.40	1.09	1.38	1.18
413	Lipton's, Hoboken, N. J. *Yellow Label*	11.09	4.25	15.25	1.51	1.16	1.44	1.19
495	Logan Bros. Co., Bridgeport. *Midas Highest Quality*	13.00	4.10	14.58	1.35	1.23	1.27	1.20
417	Logan Bros. Co., Bridgeport. *Mojav*	13.29	4.15	14.45	1.31	1.16	1.30	1.19

TABLE III. ANALYSES OF COFFEE, ETC.—*Concluded.*

Station No.	Manufacturer or Dealer and Brand Name	Soluble Solids	Ash	Fat	Caffeine: Fendler-Stüber Method, Grav.	Caffeine: Fendler-Stüber Method, From N.	Caffeine: Bailey-Andrew Method, Grav.	Caffeine: Bailey-Andrew Method, From N.
		%	%	%	%	%	%	%
	COFFEE—*Continued.*							
465	Wm. T. Reynolds & Co., Poughkeepsie, N. Y. *Reynolds' Reliance Steel Cut Coffee*	11.55	4.33	14.48	1.26	1.18	1.24	1.17
459	E. Schoenberger & Sons, New Haven. *Ground Coffee*	11.48	4.28	14.50	1.26	1.18	1.32	1.18
444	United States Stores System. *Rex Blend*	10.69	4.05	14.58	1.24	1.16	1.23	1.17
439	R. C. Williams & Co., Inc., N. Y. *Royal Scarlet Brand*	10.95	4.25	13.90	1.24	1.13	1.30	1.17
	Modified Coffee and Coffee Substitute.							
458	E. Schoenberger & Sons, New Haven. *Kaffee Hag*	10.20	4.05	13.58	0.16	0.10	0.20	0.09
454	Hartford Market Co., Hartford. *Coffee Substitute*	11.05	5.48	8.35	0.70	0.62	0.69	0.59

Diabetic, Special and Miscellaneous Foods.

(Analyses are given in Table IV.)

GLUTEN FLOUR, ETC.

Gluten Flour should contain, on the moisture-free basis, not less than 7.1 per cent of nitrogen and not more than 44 per cent of starch.[1] All of the six samples of this type of flour examined met these requirements.

Two samples of Diaban diabetic flour were analyzed. Literature accompanying the samples states that this flour is made from wheat, edible nuts, casein with flavoring and leavening agents. Wheat flour contains 75 to 80 per cent of carbohydrate, whereas the two samples of Diaban diabetic flour contained about 38.5 and 43.0 per cent respectively of this constituent, which is substantially one half the amount generally found in wheat flour.

Jireh "Starch-Treated" flour was not sold as "gluten" flour nor as "diabetic" flour. Whatever "treatment" the flour has undergone it contains practically the same amount of carbohydrate as the average of wheat flours, and over 60 per cent of starch as determined by the diastase method.

NON-NUTRITIVE FLOUR, ETC.

Cellulose flour and Vitae Special Starch-free Bran are both made from the husks of the soy bean. In both of these products the greater part of the carbohydrate belongs to the undetermined nitrogen-free extract and consists chiefly of hemicellulose complexes not generally regarded as a source of danger in the diabetic diet. The term "bran" indicates a cereal product, and generally in human foods, a wheat product. The term "starch-free bran," therefore, in this instance is misleading.

Callard's Washed Bran is free from any determinable amount of starch.

BAKERY PRODUCTS.

Since gluten flours vary greatly in composition, containing from 40 per cent protein (as required by the standard) to 80 per cent, it follows that gluten breads vary according to the flour used. These breads aim to fill a need in the diabetic diet for a bread of relatively low carbohydrate content. This reduction in carbohydrate is effected at the expense of an increase in protein and, when carried to extremes, the greatly increased protein becomes a disadvantage in itself. In advising a patient upon questions of diet the physician will, therefore, need to know the

[1] Circ. 136, Office of the Secretary, U. S. Dept. Agr.

composition of the particular bread in question, and he should keep in mind also the composition of ordinary wheat bread for comparison. On the basis of about 35 per cent of water, ordinary bread contains about 9 per cent of protein and 53 per cent of carbohydrate; or, on the basis of the moisture found in hard (dry) breads, viz., about 5 per cent, 13 per cent protein and 77 per cent of carbohydrate.

Of the gluten breads examined, the soft breads, i. e. those containing approximately 35 per cent of moisture, have a protein content of from 17 to 31 per cent and contain from 24 to 39 per cent of carbohydrate. This is excluding **32805** which does not differ from ordinary wheat bread. The hard (dry) breads contain about 5 per cent of moisture, from 21 to 73 per cent of protein and from 13 to 49 per cent of carbohydrate. The bread which is lowest in carbohydrate, **32810**, contains only 6 per cent of available carbohydrate, as such, but the 73 per cent of protein which accompanies it is a potential source of a very considerable amount of sugar. In the other dry bread, **2337**, the amount of carbohydrate is practically the same as in wheat bread.

The soluble carbohydrate, calculated as dextrose, in products containing agar, **2703** and **1204**, is enhanced somewhat by reducing sugars obtained from that substance after hydrolysis, but which are regarded as indigestible.

The fat content of two samples is high, due in one case, **2337**, to added vegetable oils, and in the other, **3175**, largely to butter.

The baked products of Callard & Co. are in most cases high in fat, which, so far as could be determined, is digestible fat or oil. No evidence of mineral oil was obtained. The "fat" in Nutrivoid Bran Wafers, **1240**, is largely mineral oil and is indigestible. Whether the fat in Cellu products, **1241**, **1242** and **1243** is, in part, due to mineral oil was not determined.

CONFECTIONS AND FRUIT PRODUCTS.

No evidence of mineral oil was found in the confections of Callard & Co. and the fat is, therefore, presumably assimilable. The chocolate creams, **2710**, and Marzipan chocolate, **2706**, contain glycerine according to information furnished by the manufacturer.

Our information from the same source is that the Callard jellies, jams, marmalade and fruit in syrup are packed with from 10 to 45 per cent of glycerine.

TABLE IV. SO-CALLED "DIABETIC," SPECIAL AND MISCELLANEOUS FOODS.

No.	Manufacturer and Brand	Moisture	Ash	Nitrogen	Protein N x 6.25	Protein N x 5.7	Fiber	Nitrogen-free Extract: Starch	Nitrogen-free Extract: Sugar as Dextrose	Nitrogen-free Extract: Other N-free Extract	Fat, Ether Extract
		%	%	%	%	%	%	%	%	%	%
	Flour, Meals, etc.										
	Battle Creek Food Co., Battle Creek, Mich.										
31142	Gluten Flour	8.08	0.93	7.57	....	43.15	0.34	36.45	2.88	6.35	1.82
	Callard & Co., London										
2701	Washed Bran	8.60	4.37	1.66	10.38	....	21.48	none	2.31	46.41	6.45
	The Farwell & Rhines Co., Watertown, N. Y.										
31144	Gluten Flour	8.23	0.72	7.38	....	42.07	0.29	37.91	3.08	6.30	1.40
	Jireh Food Company, Inc., Morris Plains, N. J.										
32334	Jireh "Starch Treated" Flour	8.08	1.36	2.14	13.38	....	1.29	60.47	5.48	7.89	2.05
	MacDowell Bros., Ogdensburg, N. Y.										
1290	Diaban Diabetic Flour	6.78	6.46	4.48	28.00	....	2.15	32.06		6.48	18.07
3201	Diaban Diabetic Flour	5.95	6.15	4.17	26.06	....	1.35	28.13	5.04	9.97	17.35
	Potter-Wrightington, Inc., Boston, Mass.										
31143	Gluten Flour, Diet-Ease	7.93	1.18	7.12	....	40.58	0.44	33.58	4.80	8.89	2.60
32884	Gluten Flour, Diet-Ease	7.74	1.76	7.03	....	40.07	0.46	34.88	5.72	6.54	2.83

TABLE IV. SO-CALLED "DIABETIC," SPECIAL, AND MISCELLANEOUS FOODS—*Continued.*

No.	Manufacturer and Brand	Moisture	Ash	Nitrogen	Protein N x 6.25	Protein N x 5.7	Fiber	Nitrogen-free Extract: Starch	Nitrogen-free Extract: Sugar as Dextrose	Nitrogen-free Extract: Other N-free Extract	Fat, Ether Extract
	Flour, Meals, etc.—Concluded.	%	%	%	%	%	%	%	%	%	%
	Pieser-Livingston Co., Chicago, Ill.										
32643	Gluten Flour	8.78	0.89	7.37	....	42.01	0.30	35.33	4.04	6.96	1.69
	The Pure Gluten Food Co., New York City.										
32335	Gluten Flour (Hoyt's)	8.23	0.94	7.56	....	43.09	0.28	34.65	5.76	5.20	1.85
	Vitae Health Food Co., Seattle, Wash.										
2516	Cellulose Flour	9.95	4.18	1.85	11.56	....	32.33	none	3.76	35.42	2.80
2624	Vitae Special Starch-Free Bran	9.75	4.39	3.58	22.38	....	20.98	none	5.80	27.77	8.93
	Bakery Products, etc.										
	Barker System of Bakeries, Hartford, Conn.										
32734	Gluten Bread	38.71	1.91	2.93	....	16.68	0.40	26.38	5.92	6.45	3.55
	Beroth Bread Shop, Hartford, Conn.										
32735	Gluten Bread	33.28	2.65	5.02	....	28.60	0.42	19.04	4.28	7.13	4.60
	Bibeau, Meriden, Conn.										
32805	Gluten Bread	38.87	2.31	1.51	....	8.58	0.92	34.02	7.79	6.13	1.38

TABLE IV. SO-CALLED "DIABETIC," SPECIAL, AND MISCELLANEOUS FOODS—*Continued.*

No.	Manufacturer and Brand	Moisture	Ash	Nitrogen	Protein N x 6.25	Protein N x 5.7	Fiber	Nitrogen-free Extract: Starch	Nitrogen-free Extract: Sugar as Dextrose	Nitrogen-free Extract: Other N-free Extract	Fat, Ether Extract
		%	%	%	%	%	%	%	%	%	%
	Bakery Products, etc.—Continued.										
	Callard & Co., London.										
2703	Bran and Agar Biscuits ("Cellulon")	10.15	4.51	1.75	10.94	....	15.93	none	10.90	40.57	7.00
2709	Chocolate Biscuits ("Casoid")	4.30	4.25	3.68	23.00	....	2.00		5.44	9.43	51.58
2702	Starchless Ginger Biscuits	3.83	3.41	4.38	27.38	....	1.28	none	2.68	4.49	56.93
	Chicago Dietetic Supply House.										
1244	Bran Agar Agar Wafers	5.85	7.32	1.91	11.94	....	13.10	trace	8.24	47.86	5.69
1243	Cellu Bran Wafers	4.28	4.17	0.66	4.13	....	21.50	none	3.05	38.63	24.24
1241	Cellu Cheese Wafers	3.48	3.21	1.24	7.75	....	21.15	none	2.31	31.46	30.64
1242	Cellu Chocolate Wafers	4.08	3.43	1.04	6.50	....	19.18	2.11	1.44	34.93	28.33
	Community Bake Shop, Norwich, Conn.										
32800	Gluten Bread	33.37	2.37	5.42	....	30.88	0.51	18.33	3.99	5.76	4.79
	Fougeron, Paris.										
2337	Pain Anti-diabétique	6.75	2.95	3.34	20.88	....	0.48	34.34	9.04	5.51	20.05
	Hallinan's Bakery, New Britain.										
32728	Gluten Bread	33.40	1.97	4.83	....	27.54	0.46	19.30	4.08	7.50	5.75

TABLE IV. SO-CALLED "DIABETIC," SPECIAL, AND MISCELLANEOUS FOODS—*Continued.*

No.	Manufacturer and Brand	Moisture	Ash	Nitrogen	Protein: N x 6.25	Protein: N x 5.7	Fiber	Nitrogen-free Extract: Starch	Nitrogen-free Extract: Sugar as Dextrose	Nitrogen-free Extract: Other N-free Extract	Fat, Ether Extract
	Bakery Products, etc.—Concluded.	%	%	%	%	%	%	%	%	%	%
	Keney Tower Bakery, Hartford.										
32811	Gluten Bread	37.79	3.19	3.61	....	20.57	0.34	27.25	2.55	3.29	5.02
	Mory's Bakery, New Haven.										
32736	Gluten Bread	38.30	1.30	4.92	....	28.06	0.18	21.08	2.91	4.30	3.87
	Nutrivoid Diabetic Flour Co.										
1240	Nutrivoid Bran Wafers	4.98	6.33	0.92	5.75	....	8.68	none	4.20	38.98	31.08
	Mrs. Root's Food Shop, New Haven.										
32737	Gluten Bread	35.91	1.00	5.06	....	28.85	0.20	18.93	4.98	5.05	5.08
	Schaeffer Bros., Inc., Middletown										
32807	Gluten Bread	34.22	2.69	4.87	....	27.75	0.43	20.19	4.87	5.32	4.53
	Therapeutic Foods Co., Inc., New York.										
32810	Gluten Bread	5.67	4.59	12.81	....	73.02	0.26	4.67	1.26	6.85	3.68
	Washburn-Crosby Co., Minneapolis.										
3175	Gluten Bread	27.23	3.71	4.13	....	23.56	2.26	8.66	1.58	13.49	19.51

TABLE IV. SO-CALLED "DIABETIC," SPECIAL, AND MISCELLANEOUS FOODS—*Continued.*

No.	Manufacturer and Brand	Moisture	Ash	Nitrogen	Protein N x 6.25	Protein N x 5.7	Fiber	Nitrogen-free Extract: Starch	Nitrogen-free Extract: Sugar as Dextrose	Nitrogen-free Extract: Other N-free Extract	Fat, Ether Extract
		%	%	%	%	%	%	%	%	%	%
	Confections.										
	Callard & Co., London.										
2710	Chocolate Creams ("Casoid")	11.80	2.77	3.48	21.75	....	1.58		4.75	35.80	21.55
2708	Chocolate Peppermints ("Casoid")	12.98	2.66	3.57	22.31	....	1.48		4.06	36.03	20.48
2707	Chocolate Truffles ("Casoid")	5.90	3.43	4.44	27.75	....	1.78		5.19	9.25	46.70
2706	Marzipan Chocolate ("Casoid")	7.50	3.44	3.96	24.75	....	1.70		4.19	21.24	37.18
2704	Ponos Marzipan	13.42	2.38	3.22	20.13	....	2.50	none	3.08	23.83	34.66
2705	Ponos Marzipan (creme de menthe)	9.74	2.63	3.48	21.75	....	1.89	none	2.72	15.91	45.36
	Fruits and Vegetables (Fresh).										
2729	Des Moines Squash	84.42	1.13	0.25	1.55	....	1.56	5.18	3.48	2.58	0.10
2730	Des Moines Squash	87.96	0.83	0.21	1.33	....	1.23	3.77	2.60	2.17	0.11
	Fruits and Vegetables (Canned).										
	Callard & Co., London.										
2712	Cranberries, Callard's Sugarless Fruit	82.24	0.14	0.05	0.31	....	1.00	none	1.33	....	....
2711	Plums, Callard's Sugarless Fruit	76.44	0.17	0.04	0.25	....	0.28	none	1.46	....	....
	John Sexton & Co., Chicago.										
2629	Alp Rose Refugee Beans (small green)	95.26	0.33	0.17	1.03	....	0.48	0.09	1.35	1.41	0.05
[illegible]	Alp Rose Beets (small)	84.17	0.48	0.20	1.28	....	1.04	0.31	8.08	4.59	0.05

TABLE IV. SO-CALLED "DIABETIC," SPECIAL, AND MISCELLANEOUS FOODS—*Continued.*

No.	Manufacturer and Brand	Moisture	Ash	Nitrogen	Protein N x 6.25	Protein N x 5.7	Fiber	Nitrogen-free Extract: Starch	Nitrogen-free Extract: Sugar as Dextrose	Nitrogen-free Extract: *Other N-free* Extract	Fat, Ether Extract
	Fruits and Vegetables (Canned)—Concl'd.	%	%	%	%	%	%	%	%	%	%
	John Sexton & Co., Chicago.										
2628	Alp Rose Black Cherries	82.60	0.40	0.09	0.56	....	0.19	none	9.95	6.04	0.26
2627	Alp Rose Red Pitted Cherries	86.76	0.34	0.08	0.51	....	0.19	none	6.99	4.94	0.27
2630	Alp Rose Peas (sifted early June)	90.16	0.32	0.42	2.64	....	1.06	2.62	1.55	1.45	0.20
2625	Alp Rose Black Raspberries	87.98	0.39	0.13	0.81	....	2.58	none	3.34	3.83	1.07
2626	Alp Rose Strawberries	93.83	0.30	0.07	0.43	....	0.72	none	2.03	2.37	0.32
1436	Edelweiss Sauer Kraut	93.60	1.77[1]	0.18	1.10	....	0.66	0.08	0.33	2.31	0.15
1438	Alp Rose Spinach	91.94	1.17[2]	0.46	2.87	....	0.65	0.19	0.80	1.92	0.46
1435	Alp Rose Sweet Corn	83.23	0.53[3]	0.34	2.11	....	0.31	2.42	7.85	2.46	1.09
	Washington County Company, Dennysville, Me.										
2031	Aunty's Mountain Cranberries	82.76	0.24	0.08	0.48	....	1.01	none	3.28	11.39	0.84
2030	Aunty's Blueberries	81.35	0.28	0.10	0.66	....	1.53	none	8.04	7.21	0.93

[1] Salt (NaCl), 1.29%.
[2] Salt (NaCl), 0.06%.
[3] Salt (NaCl), 0.04%.

TABLE IV. SO-CALLED "DIABETIC," SPECIAL, AND MISCELLANEOUS FOODS—*Concluded*.

No.	Manufacturer and Brand	Moisture	Ash	Nitrogen	Protein N x 6.25	Protein N x 5.7	Fiber	Starch	Nitrogen-free Extract: Sugar as Dextrose	Nitrogen-free Extract: Other N-free Extract	Fat, Ether Extract
	Jams and Marmalades. *Callard & Co., London.*	%	%	%	%	%	%	%	%	%	%
2717	Sugarless Jam (apricot)	61.62	0.43	0.71	3.94[1]	....	0.30	none	3.34	....	....
2714	Sugarless Jam (green gage plums)	60.68	0.39	0.90	5.00[1]	....	0.29	none	2.75	....	....
2715	Sugarless Marmalade (orange)	59.64	0.37	1.04	5.77[1]	....	0.55	none	1.15	....	....
2713	Sugarless Pineapple Jelly	80.44	0.28	1.23	6.83[1]	....	none	none	none	....	....
2716	Sugarless Jam (plum)	67.42	0.33	0.90	5.00[1]	....	0.28	none	1.68	....	....
	Miscellaneous.										
2384	Soy Bean Meal	....	6.63[2]	....	....	....	....	....	....	....	....

[1] Calculated as gelatine—factor N x 5.55.
[2] Lime (CaO), 0.42%; Phosphoric acid (P_2O_5), 1.92%.

Eggs.

Twenty-four samples of eggs were submitted by the Dairy and Food Commissioner, and one sample by the Department of Health of New Haven. The eggs were sold as "fresh eggs" and examinations were made to determine whether they showed the characteristics indicated by that description.

Eight samples were passed as fresh and sixteen were found to be not fresh although in most cases they were edible. In these eggs the air spaces were generally in excess of 1 inch in diameter, yolks were settled in the shell and ammoniacal nitrogen ranged from 1.4 to 3.6 mgms. per 100 gms. of egg, averaging 2.1 mgms.

In those samples which were passed the ammoniacal nitrogen ranged from 0.9 to 1.7 mgms. per 100 gms. and averaged 1.3 mgms. The air spaces were relatively small (less than 1 inch), in all cases.

Table V. Examination of Eggs.

No.	City or Town	Dealer	Sold for	Remarks
32864	*Ansonia*	M. Gorosko	Cold storage eggs	Not Fresh
32865		A. Remkun	Fresh eggs	Not Fresh
32863		Lesko Dencsko	Fresh eggs	Not Fresh
32877	*Bloomfield*	H. Fairman	Fresh eggs	Not Fresh
29468	*Bridgeport*	E. Tancos	Fresh eggs	Not Fresh
32955	*Colchester*	C. H. Levine	Fresh eggs	Pass.
32951	*Glastonbury*	Joseph C. Tiboni	Fresh eggs	Pass.
32850	*Hartford*	Austin's Market Co.	Fresh eggs	Not Fresh
32956		Antonio Parano	Fresh eggs	Not Fresh
31125		S. Satriano	Western fresh eggs	Not Fresh
31271		West Hill Grocery	Fresh eggs	Pass.
32953	*Moodus*	I. Beckeroff	Fresh eggs	Pass.
32952		M. Elkin	Fresh eggs	Pass.
32954		M. Sonkin	Fresh eggs	Pass.
3111[1]	*New Haven*	Submitted by City Board of Health	Fresh eggs	Not Fresh
32646		A. Malfonte	Fresh eggs	Not Fresh
32957	*No. Westchester*	S. Elkin	Fresh eggs	Pass.
32958	*Rockville*	Sam Sokolor	Fresh eggs	Pass.
32627	*Waterbury*	C. Bencivenga	Fresh eggs	Not Fresh
32628		Eastern Provision Co.	Fresh eggs	Not Fresh
32629		Quality Market	Fresh eggs	Not Fresh
32625		United Meat Market & Groc. Co.	Fresh eggs	Not Fresh
32626		United Meat Market & Groc. Co.	Fresh eggs	Not Fresh
32799	*West Simsbury*	R. A. Fyler	Fresh eggs	Not Fresh

[1] Station No.

Fat and Oils.

Twenty-three samples of butter were examined, eighteen of which were not found adulterated. Four were adulterated by reason of an excess of water or deficiency of fat, or both, and one was short weight.

The water in the adulterated samples ranged from 19.6 to 29.7 per cent. The short weight sample was 1.1 ozs. short of one pound.

Adulterated and misbranded samples are listed as follows:

No.	City or Town	Dealer	Manufacturer	Sold for	Remarks
3063	*Bridgeport*	Oak Hill Dairy	Own make	Sweet butter	Excess water, Low in fat.
2251	*Hartford*	S. Gold	....	Butter	Excess water, Low in fat.
2961		S. Gold	....	Sweet butter	Excess water.
2959	*Moodus*	I. Buckeroff	....	Sweet butter	Short weight.
0573	*New Haven*	A. Gold	Own make	Sweet butter	Excess water.

OLEOMARGARINE.

Two samples of oleomargarine, **31268** and **31269**, made by the Verco Nut Products Co., Providence, R. I., were submitted by the Norwich State Hospital through the office of the Dairy and Food Commissioner. The analyses indicated that both were vegetable margarines.

35078. A sample labelled Higgins Nut Product made by the Higgins Manufacturing Co., Providence, R. I., was examined as follows:

Water 9.8 per cent; fat 87.9 per cent; nitrogen none; salt 2.3 per cent; Reichert-Meissel No. 5.8; Refraction at 40° C. 38.2; Halphen test for cottonseed oil positive; color turmeric.

This analysis is substantially the same as that of a similar product called Nut-z-all made by the same manufacturer and examined by us in 1923,[1] except that no cottonseed oil was detected at that time and the product was not found to be colored. The product has essentially the same composition as the vegetable margarines which we have examined; but it is our understanding that the product is not taxable as oleomargarine under a decision of the Treasury Department. The product, however, is imitation butter as that product is defined in the Statute (Sec. 2449).

LARD.

Sixteen samples of lard were submitted by the Dairy and Food Commissioner and all were passed as genuine. Refraction at 40° C was determined and the Halphen and Belfield-Gladding

[1] Conn. Exp. Sta. Bull. 255, p. 188.

tests were applied. The melting point of the glycerides were also observed in some cases.

The list of brands examined is as follows:

No.	City or Town	Local Dealer	Manufacturer
33072	*Bridgeport*	Atlantic & Pacific Groc. Co.	International Provision Co., Brooklyn N. Y.
32739	*Bristol*	Bristol Public Market	Goebel's, New York
32798	*Meriden*	Atlantic & Pacific Tea Co.	....
33073		*Atlantic & Pacific Tea Co.*	*Independent Packing Co.*
32771		Bushnell's Grocery	Swift & Co.
32770		Economy Grocery Co.	Otto Stahl, New York
32780		Russell Bros.	Armour & Co.
33075	*New Haven*	Long Island Grocery	Federal Packing Co.
33076		People's Market	Morris & Co.
32745	*Plainville*	W. J. Hemingway	Parker, Webb, Detroit, Mich.
32803	*Waterbury*	Atlantic & Pacific Tea Co.	Danahy Packing Co., Buffalo
32802		B. M. Freeman	Sperry & Barnes, New Haven
32782	*Wallingford*	Central Market	John Morrello & Co., Boston
32781		Kelman's Market	Wilson & Co.
33069	*Winsted*	J. P. Gagner & Co.	Cudahy Packing Co.
33071		J. A. Redochio	Albany Packing Co., Albany, N. Y.

OLIVE OIL.

Twenty-two samples of olive oil, of which two samples were found to be adulterated with cottonseed oil, were examined for the Dairy and Food Commissioner. Two other samples were tested for the research laboratory of this station.

The official samples examined are listed as follows:

No.	City or Town	Local Dealer	Manufacturer, Importer or Jobber	Remarks
32738	*Bristol*	Bristol Public Market	Rome Importing Co., Italy	Passed
32740		A. J. Duval	Jose Ban, Tortosa, Spain	Passed
32741		D. Nicotera	Musolino & Berger, Boston	Passed
32742		D. Nicotera	Alberti Importing & Ex. Co., Boston	Passed
26916	*Hartford*	International Importing Co.	....	Adulterated
26917		International Importing Co.	....	Adulterated
32778	*Meriden*	Dubin Butter Co.	Jose Ban, Tortosa, Spain	Passed
32779		Dubin Butter Co.	....	Passed
32806	*Middletown*	Main and Washington St. Fruitery	R. C. Williams Co., New York	Passed
32733	*New Britain*	Atlantic & Pacific Tea Co.	....	Passed
32730		Economy Grocery	Lamauro, Azema & Farnan, New York	Passed
32731		Mohican Co.	Austin, Nichols Co., New York	Passed
32732		Mohican Co.	Carmelo Co., New York	Passed
32729		James Spinetta	Parodi, Erminio & Co., Inc., New York	Passed

No.	City or Town	Local Dealer	Manufacturer, Importer or Jobber	Remarks
32801	*Norwich*	R. F. Smith	Los Angeles Olive Growers' Asso., Los Angeles, Cal....	Passed
32743	*Plainville*	W. J. Hemingway	Guglielmo Co., Genovo, Italy	Passed
32744		W. J. Hemingway	R. C. Williams Co., New York	Passed
32746		Modern Market Co.	L. A. Manzie, Worcester, Mass.	Passed
32804	*Waterbury*	Frank Pepe	Frank Pepe, Waterbury, Conn.	Passed
32747	*Willimantic*	F. B. Lombardo	Iwan Berger, Inc., New York	Passed
32748		F. B. Lombardo	Philip Berio & Co., Lucca, Italy	Passed
32749		C. Stomaton	Enrico Ganni Co., Italy	Passed

Flavoring Extracts.

(Analyses given in Table VI.)

VANILLA EXTRACTS.

Five samples of vanilla extract have been examined for the Dairy and Food Commissioner. Four of these, viz., Puritan. Royal Scarlet, Morrow's and Champion brands, were official samples taken in connection with the station's inspection of these products a year ago and the results substantiated those previously reported.[1] Morrow's was adulterated. Sample **33060**, sold for pure extract of vanilla and manufactured by Chas. H. Baldwin and Son, West Stockbridge, Mass., was found to be of substandard quality.

The analysis is as follows:

Lead precipitate, volume of, medium; color of, brown; color of filtrate from, dark brown. Vanillin 0.05 gm/100 cc; coumarin none; solids 34.38; ash 0.22; water-sol. ash 0.17; water insol. ash 0.05; alkalinity of ash 24.5 cc N/10 acid per 100 cc; alk. of sol. ash 15.5 cc; alk. of insol. ash 9.0 cc; acidity of total extract 25.0 cc N/10 alkali per 100 cc; acidity due to vanillin 3.8 cc; due to other than vanillin 21.2 cc; lead number 0.26.

No coumarin was found but the vanillin content is but 1/3 to 1/4 that of an extract of standard quality and the color is largely or in part due to caramel.

LEMON EXTRACT, ETC.

Thirty-eight samples of lemon extract, five samples of terpeneless lemon extract and one of lemon flavor were examined for the Dairy and Food Commissioner. Some of these were composites of two samples of the same brand taken at different sources.

Thirty-one samples of lemon extract equaled or exceeded the

[1] Conn. Exp. Sta. Bull. 267, p. 440.

required 5 per cent of lemon oil, four were 90 per cent or more of the required standard, and three were less than 90 per cent strength. One sample, **32991**, bore no declaration of net volume and in the duplicate of the same brand the color was questionable. The sample was labelled as being prepared with non-beverage alcohol which may account for the character of the color present. The lemon flavor, **32971**, cnosisted of a mineral oil base with about 5 per cent of lemon oil, and artificial color. Color was declared.

ORANGE EXTRACTS.

The seven samples examined, all except one being composites, were of standard quality and strength.

TABLE VI. ANALYSES OF FLAVORING EXTRACTS.

Number	City or Town	Dealer	Manufacturer	Oil Per cent.	Refraction of oil 25° (Butyro-refrac.)	Alcohol by vol. Per cent.	Solids Gms. per 100 cc.	Color
		Lemon Extract.						
32878	*Bridgeport*	Bridgeport Public Market	Baker Ext. Co.	5.3	69.5	80.00	0.130	natural
32761 32972	*Bristol*	L. L. Glasson	F. E. Harris Co.	6.2	69.3	83.36	0.120	"
32754 32895	*Bristol* *Hartford*	North Side Market Wm. Boardman & Sons Co.	Wm. Boardman & Sons Co.	5.8	69.0	85.92	0.130	"
32753 32980	*Bristol* *Hartford*	Public Market Conn. Grocery Co.	Hallock-Denton Co.	5.6	70.0	82.56	0.260	"
32750 32856	*Bristol* *Branford*	W. A. VanNess Charles Reynolds	Schlotterbeck & Foss	0.2	69.0	82.00	0.200	"
32755 32966	*Bristol* *Hartford*	W. B. Woodruff The Sisson Drug Co.	*The Sisson* Drug Co.	5.2	72.0	82.80	0.085	"
32762 32893	*Hartford*	Clark's Market	R. C. Williams & Co.	5.0	69.0	87.60	0.215	"
32769 32891	*Hartford*	G. Fox & Co.	The Belmont Co.	5.2	69.6	84.48	0.100	"
32763 32894	*Hartford*	A. H. Phillips, Inc.	A. H. Phillips, Inc.	5.2	68.8	79.36	0.100	"
32772 32890	*Hartford*	Sage-Allen Co., Inc.	Brewer & Co.	5.2	70.5	89.44	0.105	"
32764 32892	*Hartford*	Tunnell Grocery Co.	Loomis & Wilson Co.	5.1	69.3	88.96	0.135	"
32765 32852	*Hartford*	Tunnell Grocery Co. Austin's Market, Inc.	Williams & Carlton Co.	6.4	70.5	81.92	0.335	"

TABLE VI. ANALYSES OF FLAVORING EXTRACTS—*Continued.*

Number	City or Town	Dealer	Manufacturer	Oil Per cent.	Refraction of oil 25° (Butyro-refrac.)	Alcohol by vol. Per cent.	Solids Gms. per 100 cc.	Color
		***Lemon Extract*—Con.**						
32882	*New Britain*	Miller & Olson, Inc.	Sprague, Warner & Co.	10.8	69.2	78.00	0.815	natural
32883		Miller & Olson, Inc.	Baker Ext. Co.	6.8	69.0	84.00	0.140	"
32631 32793	*New Haven* *Stamford*	Atlantic & Pacific Tea Co.	Atlantic & Pacific Tea Co.	4.4	70.0	73.60	0.410	"
33054	*New London*	Atlantic & Pacific Tea Co.	Atlantic & Pacific Tea Co.	5.1	70.1	81.28	....	"
32649 32986	*New Haven*	Beirne's Pharmacy	Hance Bros. & White	2.0	70.2	67.60	0.070	"
32648 32857	*New Haven* *Branford*	Economy Grocery Economy Grocery	Garrett & Co.	11.4	70.0	80.00	0.280	"
32639 32860	*New Haven*	Grand Union Tea Co.	Grand Union Tea Co.	6.0	70.2	80.40	0.075	"
32640 32875	*New Haven* *New London*	The Mohican Co.	The Mohican Co.	6.2	70.0	80.56	0.090	"
32637 32789	*New Haven* *Westport*	R. J. Smith & Co. D. Sachs	Joseph Burnett & Co.	12.8	70.0	80.80	0.320	"
32642 32797	*New Haven* *Stamford*	Van Dyk Co. Van Dyk Co.	Van Dyk Co.	9.9	69.3	87.60	0.200	"
32786	*Norwalk*	James Butler, Inc.	James Butler, Inc.	5.7	69.5	88.40	0.100	"
32785	*So. Norwalk*	Andrew Davey, Inc.	Andrew Davey, Inc.	4.8	69.5	81.76	0.095	"
33061	*So. Norwalk*	Andrew Davey, Inc.	Andrew Davey, Inc.	4.7	70.2	82.00	....	"
32879	*Norwich*	The Cloverdale Co.	The Cloverdale Co.	5.7	69.0	87.20	0.140	"
32795	*Stamford*	V. Sessa	Albert Ehlers	6.4	71.5	86.00	0.115	"
32788	*Westport*	Modern Grocery Co.	McCormick & Co.	8.1	69.2	79.20	0.140	"

TABLE VI. ANALYSES OF FLAVORING EXTRACTS—*Continued.*

Number	City or Town	Dealer	Manufacturer	Oil Per cent.	Refraction of oil 25° (Butyro-refrac.)	Alcohol by vol. Per cent.	Solids Gms. per 100 cc.	Color
32878	*Norwich*	John Jordan	Seeman Bros.	6.3	69.3	79.60	0.370	natural
32633	*New Haven*	Frank Caro	Helwig & Leitch	7.0	71.0	....	....	......
32644 } 32999 }	*New Haven*	Shartenberg's	C. F. Sauer Co.	10.6	70.5	79.20	0.330	natural
32991	*New London*	The Nichols & Harris Co.	Own Make	5.8	70.0	....	0.115	"
			Own Make	6.2	69.3	82.00	....	?
33055	*New London*	The Nichols & Harris Co.	Own Make	6.9	69.9	81.60	....	?
32962	*Torrington*	M. Khoury	C. F. Slade Co.	5.5	69.4	87.20	0.125	natural
33070	*Winsted*	J. B. Nichols	C. F. Slade Co.	4.9	69.9	88.96	....	"
32898	*Winsted*	J. A. Reddocchio	C. H. Baldwin & Son	4.5	69.1	80.80	0.130	"
33059	*Winsted*	J. A. Reddocchio	C. H. Baldwin & Son	4.4	70.2	79.60	....	"
		Terpeneless Lemon Extract						
32899	*Bridgeport*	A. Klein	Ross W. Weir & Co.	0.0	....	45.36	0.260	"
32636 } 32984 }	*New Haven*	White Rose Food Shop; Star Paper Co.	Blackstone Mfg. Co.	trace	....	48.16	3.310	"
32635 } 32992 }	*New Haven*	M. Cretella	Diamond Seal Products Co., Inc.	trace	....	42.40	0.065	"
32634 } 32871 }	*New Haven*; *New London*	B. Dickstein; National Economy Grocery Co.	Boyce Extract Co.	none	....	43.60	0.025	"
32632 } 32794 }	*New Haven*; *Stamford*	T. J. Foley; B. Masone	Morrow & Co.	none	....	53.76	0.110	"

TABLE VI. ANALYSES OF FLAVORING EXTRACTS—*Concluded.*

Number	City or Town	Dealer	Manufacturer	Oil Per cent.	Refraction of oil 25° (Butyro-refrac.)	Alcohol by vol. Per cent.	Solids Gms. per 100 cc.	Color
		Lemon Flavor.						
32971	*Bristol*	W. B. Woodruff	Burrill's	4.8	....	none	80.81	artificial
		Orange Extract.						
32851	*Hartford*	Austin's Market, Inc.	R. C. Williams & Co.	5.6	67.5	85.60	0.680	natural
32630, 32792	*New Haven*	Atlantic & Pacific Tea Co.	Atlantic & Pacific Tea Co.	5.4	67.0	86.00	0.385	"
33052	*New Haven*	Atlantic & Pacific Tea Co.	Atlantic & Pacific Tea Co.	5.4	68.4	86.00	....	"
32647, 32985	*New Haven*	Dingwall Bros.	Van Duzer Extract Co.	6.0	67.0	85.12	0.085	"
32638, 32859	*New Haven*	Grand Union Tea Co.	Grand Union Tea Co.	6.0	67.5	80.40	0.655	"
32645, 32861	*New Haven*	Shartenberg's	Austin, Nichols & Co.	6.6	67.2	80.80	0.125	"
32641, 32796	*New Haven*	Van Dyk Co.	Van Dyk Co.	10.0	67.0	84.48	0.145	"

Gelatin.

Seven samples of gelatin were collected by the station agent and analyses are given in Table VII. Arsenic did not exceed 1 part in 700,000 in any case, the fat and keratin were low, and the products were free from objectionable odor when dissolved in hot water.

Table VII. Analyses of Gelatin.

Sta. No.	Brand	Water %	Ash %	Nitrogen %	Gelatin (N x 5.55) %	Fat %	Keratin %
475	A. & P. Gelatin	10.03	1.32	16.06	89.13	0.03	0.03
469	Boston Brand Crystal Gelatin	11.02	1.32	15.88	88.13	0.05	0.04
473	Cox's Instant Powdered Gelatin	10.67	1.58	15.86	88.02	0.06	0.05
477	Knox Plain Sparkling Gelatin	10.70	1.36	15.88	88.13	0.15	0.09
489	Peter Cooper's Clarified Gelatin	10.73	3.55	15.42	85.58	0.09	0.07
467	Plain Minute Gelatin	10.87	1.67	15.62	86.69	0.07	0.05
482	Plymouth Rock Phosphated Gelatin	7.52	1.96	14.35	79.64	0.11	0.07

Ice Cream.

Four hundred and five samples of ice cream were examined for the Dairy and Food Commissioner. Of the total number only seven samples contained less than the 8 per cent of fat required by the State standard, and four of these were but slightly deficient and were passed. The three which were deficient in substantial amounts were as follows:

			% Fat
31106	*Ansonia*	Purity Confectionery Co.	6.4
31113	*New Haven*	Olympia Candy Co.	6.8
32709	*New London*	College Pharmacy	5.6

The distribution of samples on the basis of fat content is as follows:

Per cent of fat	No. of Samples	Per cent of total 1925	Per cent for 1924	Per cent for 5 yr. period 1919-1923
8.0 to 9.9	69	17.0	17.4	26.1
10.0 to 11.9	140	34.6	24.8	23.2
12.0 and above	189	46.7	55.9	41.1
7.9 and below	7	1.7	1.9	9.6

This summary shows that for the past two years about 80 per cent of the samples examined have contained 10 per cent or more of fat; and about 50 per cent of all samples have contained 12 per cent or more. As compared with the 5 year period previous to 1924 the percentage of fat in ice cream appears to be on the increase

Seven samples submitted by manufacturers for checking purposes require no special comment.

Meat Products.

All samples of meat products were submitted by the Dairy and Food Commissioner to be examined for the illegal use of cereal, color, or preservatives.

HAMBURG STEAK.

Of fourteen samples of hamburg steak three were found to contain sulphites and were, therefore, adulterated. The amounts found were equivalent to from 512 to 1144 mgms. of sulphur dioxide per kilo of meat.

These samples were as follows:

No.	City or Town	Dealer or Manufacturer
30567	*Ansonia*	M. Brown & Co.
30562	*New Haven*	F. X. Hutmacher
30563		F. X. Hutmacher

FRANKFURTS.

Sixteen samples were examined and eleven found to contain undeclared cereal or other starchy material or undeclared color, or both.

The samples were as follows:

No.	Dealer	Manufacturer	Remarks
	Branford.		
30429	Branford Public Market	T. J. McNamara, B'gp't	Color undeclared
	Bridgeport.		
30583	Cudahy Packing Co.		Color undeclared
30580	T. J. McNamara & Sons		Color undeclared
30582	New England Market		Color undeclared
	Hartford.		
30588	Hartford Center Bologna Co.	Own make	Color undeclared
	Meriden.		
30555	Henry Behrens	Own make	Starch undeclared
30554	M. Frost	T. J. McNamara & Sons, Bridgeport	Starch and color undeclared
	New Haven.		
30449	Carl Roessler	Own make	Color undeclared
	Taftville.		
30585	Otto Czikowsky	Own make	Color undeclared
30586	John Habberle	Own make	Starch and color undeclared
	Willimantic.		
30570	Joe Astmann	Own make	Starch undeclared

BOLOGNA AND BEEF SAUSAGE.

Two samples of bologna contained color which was not declared; and one sample of beef sausage contained cereal without declaration.

No.	City or Town	Dealer or Manufacturer
30581	*Bridgeport*	T. J. McNamara & Sons
30584	*New Haven*	Chas. Hertler
30441	*Bridgeport*	Coyne Bros.

PORK SAUSAGE.

Twenty-five samples of pork sausage were submitted and six were found to contain cereal or other starchy material which was not declared.

The samples were as follows:

No.	City or Town	Dealer or Manufacturer
30568	*Naugatuck*	Naugatuck Public Market
30569		P. Boylan
30411	*New Britain*	Miller & Olsen, Inc.
30419	*So. Manchester*	William Patterson
30445	*Waterbury*	S. Guiffre
30447		Verilante & Perrotti

MILK AND MILK PRODUCTS.

MARKET MILK.

Six hundred and fifty-three samples of milk have been analyzed. Of these 522 were submitted by the Dairy and Food Commissioner, 353 of them being official. One hundred and thirty-one were submitted by producers or consumers.

The results of the official inspection may be summarized as follows:

	No. of samples	Per cent
Not found adulterated	137	38.9
Adulterated by watering	42	11.9
Adulterated by skimming	10	2.8
Adulterated by watering and skimming	2	0.6
Below Standard:		
in solids and solids-not-fat	72	20.4
in solids and fat	3	0.8
in solids, fat and solids-not-fat	87	24.6
Total	353	100.0

The above classification does not at all represent the quality of our general milk supply because, as we have pointed out before, inspection samples very often are taken on complaints from distributors or from local milk inspectors.

Adulterated samples, other than those found to be substandard, are given in Table VIII.

CONDENSED MILK.

30541. A sample of sweetened condensed milk sampled at the plant of the New England Milk Products Co., Hawleyville was found to conform to the standard for condensed milk.

EVAPORATED CREAM.

30576. A sample of Walter Jahn's Evaporated Cream made by the Rico Milk Product Co., E. Troy, Wis., labelled as containing 24 per cent of fat and 31 to 33 per cent of total solids was found to conform to the declaration. It contained 25.2 per cent of fat and 31.5 per cent of solids. So-called "light" cream as obtained in the market contains from 18 to 20 per cent of fat and so-called "heavy" cream contains from 38 to 40 per cent. The term "evaporated" applied to a product containing only 25 per cent of fat is, at least, disappointing.

TABLE VIII. ADULTERATED MILK.

No.	Dealer	Solids	Fat
	Containing Added Water.		
	Bethel.		
30307	Mary Tesch	10.31	3.3
30308	Mary Tesch	10.06	2.8
	Bloomfield.		
30390	Louis Cardellico	11.29	3.5
30391	Louis Cardellico	10.64	3.2
30392	Louis Cardellico	10.66	3.3
	Bridgeport.		
30331	City Dairy Co.[1]	10.08	3.5
31561	City Dairy Co.[1]	10.86	3.3
31573	City Dairy Co.[1]	10.16	2.8
31657	John Turner	10.94	3.8
31658	John Turner	10.52	3.7
	Fairfield.		
29711	John Lucas	10.67	3.2
29709	Joseph Sleszak	10.17	3.1
	Greenwich.		
29733	Stony Wyld Farm ...	9.42	2.6
29734	Stony Wyld Farm ...	9.89	2.7
	Lebanon.		
31353	L. P. Smith	7.68	2.4
	Leonard's Bridge.		
31239	S. Hermowitz	10.07	3.2
	Mansfield Center.		
31336[2]	C. H. Kendall	....	..
31337	C. H. Kendall	7.92	2.4
	New Britain.		
30684	Joseph Scheidler	9.99	3.2
	New Hartford.		
31219	John Bullak	11.12	3.7
	New Milford.		
30322	Ed. Mitchell	11.44	3.9
30323	Ed. Mitchell	10.85	3.1
30327	A. Thompson	9.73	2.4
	Norfolk.		
31208	James Torrant	11.41	4.3
31209	James Torrant	11.36	3.6
	Containing Added Water—*Concluded.*		
	Northford.		
29882	Mrs. F. J. Buck	10.94	3.8
	Portland.		
31157	C. J. Bengstan	9.16	2.8
31160	Wm. Smoleski	11.48	4.0
31161	Wm. Smoleski	12.00	4.3
	Southbury.		
29878	Geo. Kuhne	10.65	3.0
29879	Geo. Kuhne	11.14	3.3
29880	Raymond Oberstedt ..	8.93	3.0
29881	Raymond Oberstedt ..	6.64	2.0
	Sterling.		
31313	Mrs. Frances Kasputas	10.10	3.0
	Terryville.		
29825	Frank Perkins	8.15	2.5
	Wallingford.		
30464	Wm. Quigley	10.12	3.[illegible]
30465	Wm. Quigley	10.58	2.[illegible]
	West Haven		
26948	S. J. Sorensen	10.72	3.[illegible]
26949	S. J. Sorensen	10.87	3.[illegible]
	Westport.		
29729	Wm. S. Daskam	9.05	2[illegible]
29730	Wm. S. Daskam	10.24	3[illegible]
29731	Wm. S. Daskam	10.15	3[illegible]
	Skimmed Milk.		
	Berlin.		
30685	Aziz Milco	10.75	
	Canaan.		
30745	Max Serlin	11.21	
	Eagleville.		
30063	Stanley Trostofsky ..	11.77	
	Fairfield.		
29712	C. L. & W. A. Jennings	11.24	

[1] Sampled from deliveries to the dairy.
[2] Added water indicated. Sample sour.

	Dealer	Solids	Fat	No.	Dealer	Solids	Fat
	Skimmed Milk— *Continued.*				**Skimmed Milk—** *Concluded.*		
	Leonard's Bridge.				*Shelton.*		
47	Louis Himilstein	10.71	2.3	31222	J. H. Loverin	9.20	2.0
48	Sam Lebetsky	11.14	2.4		**Watered and Skimmed.**		
49	I. Lubin	10.50	2.1				
	Norwich.				*Bridgeport.*		
92	Joseph Lobe	10.51	2.4	31559	City Dairy Co.[1]	9.93	2.5
	Plymouth.				*Stepney.*		
87	Carl Schrager	10.34	1.8	31470	Steve Gusko	10.19	2.7

Sampled from delivery to dairy.

COLOSTRUM.

Collaborating with the Department of Dairy Husbandry at Storrs, Mr. Fisher has determined the nitrogen distribution in thirty samples of milk and colostrum. Total nitrogen and casein nitrogen were determined by the official methods of the A.O.A.C.; globulin nitrogen and non-protein nitrogen were determined substantially by the procedure suggested by Howe;[1] and albumin nitrogen was obtained by difference. No attempt was made to differentiate between the several globulins cited by Howe. The results are for study in connection with investigations being conducted by the department mentioned.

MALTED MILK.

2463. *Tiffy Malted Milk* made by the Niana Pure Food Co., Waukesha, Wis., was analyzed as follows:

Moisture 3.10 per cent; ash 3.45 per cent; nitrogen 1.35 per cent; equivalent to protein 8.44 per cent (factor 6.25); fiber 0.27 per cent; nitrogen-free extract 77.34 per cent; fat 7.4 per cent. The sample contained no free starch as shown by the iodine test.

[1] Jour. Biol. Chem., 52, 51 et seq. 1922.

HUMAN MILK.

Two samples of human milk were examined for physicians. Analyses:

	1431. %	1441 %
Solids	10.38	12.55
Ash	0.23	....
Protein	1.31	....
Sugar	6.64	....
Fat	2.20	3.88

TEA.

Analyses of a number of typical teas and representative commercial brands of tea together with descriptions of their "cupping" qualities as judged by expert tasters, were reported in a previous bulletin.[1] Similar data on five other samples have been obtained during the past year and the combined results summarized and discussed in an article published elsewhere.[2] Credit for the analytical work involved is due to Messrs. Shepard and Mathis.

VINEGAR.

Two samples of vinegar were submitted by the Dairy and Food Commissioner and thirteen were examined for individuals. Of the two official samples, one was slightly deficient in acidity and the other was below the state standard for solids. According to the revised definition and standard[3] for cider vinegar, however, no numerical limit for solids is recognized.

Two samples were analyzed by Mr. Fisher in collaboration with A. O. A. C. referee on vinegar.

MISCELLANEOUS FOODS TESTED FOR POISONS, ETC.

The following articles, five in number, were submitted through the office of the Dairy and Food Commissioner or otherwise to be examined for poisonous or deleterious substances.

31292. *Tomatoes*, canned. Chemical tests showed no evidence of arsenic and a feeding test on a small animal resulted in no unfavorable symptoms.

32374. *Pie Filler.* No evidence of poisons was found after tests similar to those described in the preceding paragraph.

[1] Conn. Exp. Sta., Bull. 267, p. 458, 1924.
[2] Tea and Coffee Trade Journal, January, 1926.
[3] Food Inspection Decision 193. August, 1924.

1188. *Chili Sauce.* The sample was examined for metals only. Iron was present and insignificant traces of zinc and copper were found.

2745. *Water.* The sample contained a considerable amount of sediment consisting largely of iron. No symptoms of poison resulted on feeding the sample to a small animal.

1739. *Caramel.* The sample yielded about 0.9 per cent of ash in which iron was conspicuous.

II. DRUGS.

The year's work on drugs includes about twenty-five samples left over from the inspection of 1924 and not included in our report for that year. Many of the drugs examined during the past year were purchased on prescriptions.

The samples may be classified as follows:

Tablets, etc., from physicians' stocks	15
Tincture of iodine	1
Lime water	12
Essence of peppermint	9
Prescriptions:	
Potassium iodide	56
Arsenous acid	22
Spirits of ammonia, aromatic	46
Silver preparations, colloidal	92
Proprietary remedies	4
Toilet preparations	4
Turpentine	20
Miscellaneous	22
Total	303

Tablets, Etc. from Physicians' Stocks.

The examination of tablets was the feature of last year's work and most of the samples taken have been reported in a previous bulletin.[1]

Many of the products held over from the previous inspection and reported here are complex mixtures in which it is difficult or impossible to detect or determine all of the medicaments claimed because of inadequate methods of analysis. While it was intended to limit the inspection to such products as could be assayed by recognized methods, nevertheless a number of preparations were accepted by the inspector at the request of the

[1] Conn. Exp. Sta. Bull. 267, 1924.

physicians visited for such examination as could be made. Some of these products, therefore, have been "passed" for lack of evidence upon which to base reasonable criticism.

29220. *Cold Laxative.* Stock of Dr. T. F. Rockwell. Manufacturer not stated.

Weights of tablets 6.9 to 7.5, avg. 7.1 grs.
Claimed. Acetanilid 2 gr.; quinine sulphate ½ gr.; camphor ¼ gr.; aloin 1/16 gr.; podophyllin 1/40 gr.; aconite ext. 1/20 gr.; capsicum ¼ gr.; atrophine sulphate 1/2000 gr.
Found. Acetanilid 1.83 gr.; total alkaloids 0.46 gr.; camphor 0.3 gr.; quinine, aloin and capsicum present; podophyllin indicated.
Tablets passed.

29227. *Nephritic Pills.* Chicago Pharmacal Co., Chicago. Stock of Dr. A. S. Brackett, Bristol.

Weights of tablets 11.5 to 13.2, avg. 12.4 grs.
Claimed. Extr. asparagus seed ½ gr.; potassium nitrate 1 gr.; uva-ursi 1 gr.; apocynum 1 gr.; digitalis 1 gr.; fl. ext. cactus ¼ min.
Found. Potassium nitrate 0.91 gr. Glucosides were indicated, but specific color tests for digitalis and apocynum glucosides and for arbutin (uva-ursi) were not obtained owing to interfering color reactions. Alkaloids were not determined. The only official variety of cactus (Cactus grandiflorus N. F. IV) is alkaloid-free.
Tablets passed.

30204. *Infantile Colic Tablets.* Direct Sales Co. Stock of Dr. J. L. Pons, Devon.

Weights of tablets 1.3 to 2.0, avg. 1.8 gr.
Claimed. Paregoric 2 min.; sodium bicarbonate 1 gr.; oil of fennel 1/10 min.
Found. Total alkaloids 0.065 per cent, (morphine from 2 min. paregoric = approx. 0.04 per cent); sodium bicarbonate 1.1 gr., benzoic acid present; anise and fennel indicated.
Tablets passed.

29231. *Cascarine Compound Tablets No. 2.* The Harvey Co. Stock of Dr. A. J. Barker, Torrington.

Weights of tablets 2.0 to 2.4, avg. 2.1 grs.
Claimed. Cascarine, aloin, podophyllin, belladona extr., strychnine and ginger.
Found. Aloin, ginger, strychnine identified; cascara indicated. Total alkaloids 0.47 per cent.

The principal constituents claimed were identified qualitatively. "Cascarine" is the name given to an alleged constituent of cascara but later investigation[1] has disproved the existence of such a constituent.

[1] J. Ind. Eng. Chem., 9, 518.

29977. *Rhubarb and Ipecac Comp. Tablets.* Tailby-Nason Co. Stock of Dr. J. A. Coogan, Windsor Locks.

Weights of tablets 6.9 to 7.3, avg. 7.0 grs.
Claimed. Rhubarb powder 1 gr.; sodium bicarbonate 5 grs.; ipecac powder 1/8 gr.; oil peppermint q. s.
Found. Rhubarb, peppermint and ipecac alkaloids indicated; sodium bicarbonate 4.8 grs.; total alkaloids 0.004 gr.
Tablets passed.

30213. *Rhubarb and Ipecac Comp. Tablets.* Stock of Dr. R. Howland, Stratford.

Weights of tablets 8.6 to 9.2, avg. 8.9 grs.
Claimed. Rhubarb powder 2 grs.; sodium bicarbonate 5 grs.; ipecac powder 1/4 gr.; tinctr. nux vomica 5 mins.; oil peppermint q. s.
Found. Rhubarb, ipecac alkaloids and strychnine indicated; peppermint?; sodium bicarbonate 4.6 grs.; total alkaloids 0.007 gr.
Tablets passed.

30205. *Cathartic Compound Tablets.* Direct Sales Co. Stock of Dr. J. L. Pons, Devon.

Weights of tablets 2.1 to 2.6, avg. 2.3 grs.
Claimed. Aloin, extr. colocynth comp., extr. nux vomica, podophyllin, capsicum.
Found. Aloin, capsicum and strychnine. Total alkaloids 0.007 gr.
Tablets passed.

29925. *Strophanthus Comp. Tablets.* Standard Laboratories. Stock of Dr. C. T. Baldwin, Derby.

Weights of tablets 3.1 to 3.5, avg. 3.3 grs.
Claimed. Strychnine nitrate 1/100 gr.; tinctr. digitalis 4½ mins.; tinctr. strophanthus 1 min.
Found. Strychnine nitrate 0.011 gr.; digitalis and strophanthus not identified.
Tablets passed.

29909. *Kara Kara Comp. Tablets.* Daggett and Miller. Stock of Dr. E. R. Kelsey.

Weights of tablets 10.4 to 10.9, avg. 10.6 grs.
Claimed. Kara Kara extr. henbane, extr. cubeb, oil of sandalwood and potassium bicarbonate.
Found. Sandalwood and cubeb indicated. Potassium bicarbonate 66.9%; total alkaloids 0.025 gr.; test for atropine not conclusive.
Tablets passed.

29913. *Tono Effervescent Tablets.* National Drug Co. Stock of Dr. G. W. Eddy, Collinsville.

Weights of tablets 11.9 to 12.9, avg. 12.5 grs.
Claimed. Sodium bicarbonate 10 grs.; papain, pancreatin, ginger and oil of peppermint.

Found. Tablets effervesce in water solution; small amount of phosphate and tartaric acid present, odor of peppermint; sodium bicarbonate 10.2 grs. No action on starch was detected, but protein-digesting power was demonstrated by the methods of Rippetoe[1] indicating the presence of papain.

29976. *Tablets Blaud's Mass.* Tailby-Nason Co. Stock of Dr. J. A. Coogan, Windsor Locks.

Weight of tablets 10.0 to 10.8, avg. 10.5 grs.
Claimed. Blaud's mass 5 grs.
Found. Five grains of Blaud's mass should contain 1 grain of ferrous carbonate. Duplicate assays of these tablets showed averages of 0.20 and 0.28 grain of ferrous carbonate. Total iron calculated as ferrous carbonate 0.45 and 0.46 grain.
Tablets deficient in ferrous carbonate.

30215. *Blaud's Compound Tablets.* G. F. Harvey Co. Stock of Dr. R. Howland, Stratford.

Weights of tablets 7.0 to 7.6, avg. 7.3 grs.
Claimed. Blaud's mass 5 grs.; strychnine sulphate 1/60 gr.; corrosive sublimate 1/80 gr.; arsenous acid 1/50 gr.; capsicum; gentian extr.
Found. Ferrous carbonate 0.9 gr. (Five grains of Blaud's mass should contain 1 gr. of ferrous carbonate); total iron calculated as ferrous carbonate 0.91 gr.; arsenous acid 0.02 gr.; strychnine and mercury present.
Tablets satisfactory so far as tested.

29990. *Aspirin.* Tailby-Nason Co. Stock of Dr. W. E. Hills, Naugatuck.

Weights of tablets 5.4 to 5.8, avg. 5.6 grs.
Claimed. Aspirin 5 grs.
Found. 5.2 to 5.5, avg. 5.4 grs.
Tablets passed.

29232. *Morphine Sulphate Tablets.* Direct Sales Co. Stock of Dr. C. G. Rankin, Glastonbury.

Weights of tablets 0.57 to 0.67, avg. 0.62 gr.
Claimed. Morphine sulphate 1/4 gr.
Found. Morphine sulphate 0.28 to 0.34, avg. 0.31 gr.
Tablets high in morphine sulphate.

29958. *Elixir Peptenzyme.* Reed and Carnrick. Stock of Dr. J. F. Dowling, Hartford.

Claimed. Mixture of salivary, intestinal, peptic and splenic enzymes. Alcohol 16 per cent by volume.
Found. Alcohol 16.6 per cent. Proteolytic activity was demonstrated, but no action upon starch was detected.

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[1] J. Ind. Eng. Chem., 4, 517.

TINCTURE OF IODINE.

30575. Sampled from stock of T. F. Bannon, Winsted.

This preparation should contain from 6.5 to 7.5 grams of iodine and from 4.5 to 5.5 grams of potassium iodide, per 100 cc.

The sample contained 3.78 grams of iodine and 2.97 grams of potassium iodide, per 100 cc.

Sample was below standard.

LIME WATER.

Lime water should contain not less than 0.14 per cent of calcium hydroxide $Ca(OH)_2$ at 25° C.

The samples examined are listed in Table IX.

TABLE IX. ANALYSES OF LIME WATER.

D. C. No.	City or Town	Druggist	Calcium hydroxide found %
30438	*Bethel*	English Drug Store	0.17
30430	*Branford*	The Spalding Co.	0.16
30565	*Fairfield*	The Boyle Pharmacy	0.17
30550	*New Haven*	T. P. Gillespie & Co.	0.39[1]
30551		Wood's Drug Store	0.15
30558	*New London*	Starr Bros., Inc.	0.17
30443	*Milford*	J. H. Barnes	0.18
30579	*New Milford*	Albert Evitts	0.18
30566	*Unionville*	Paul F. Flynn	0.04
30448	*Waterbury*	Apothecaries Hall Co.	0.05
31138		Apothecaries Hall Co.	0.16
30571	*Willimantic*	The Wilson Drug Co.	0.16

Samples 30566 and 30448 are below standard.

ESSENCE OF PEPPERMINT.

Essence of peppermint should contain not less than 10 per cent by volume of peppermint oil.

The samples examined are listed in Table X.

TABLE X. ANALYSES OF ESSENCE OF PEPPERMINT.

D. C. No.	City or Town	Druggist	Peppermint oil found %
30553	*Bristol*	The Madden Drug Store	9.67
30437	*Danbury*	Doran's Drug Store	9.87
30435		Kinner & Benjamin	10.50
30433		Simon's Pharmacy	10.40
30444	*Fairfield*	The Boyle Pharmacy	10.40
30560	*Guilford*	F. F. Douden	11.24
32321	*Putnam*	J. A. P. Gagne	2.52
32616	*Union City*	E. J. Sodolosky	10.92
32457	*Winsted*	The City Pharmacy	7.60

Samples 32321 and 32457 are distinctly below standard.

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[1] Solution not clear.

Potassium Iodide.

The samples of potassium iodide were purchased on a prescription calling for 3.5 drachms of potassium iodide and sufficient distilled water to make 1 fluid ounce. Such a preparation should contain 45.5 grams of potassium iodide per 100 cc of solution, assuming the U. S. P. standard of purity for potassium iodide, viz. 99 per cent.

The results of the inspection are summarized in Table XI.

The data show that of the 56 samples examined, 27 were within 5 per cent of the strength demanded; 15 were within 10 per cent of that strength and were passed; 14 varied from that strength by more than 10 per cent. In all samples of the last named group the variations were deficiencies except in **32773** which contained an excess of medicament. In sample **32485** the two separate portions of the sample were not alike in concentration; one contained 37.83 per cent of potassium iodide and the other 41.55 per cent, the average being 39.69. This sample was improperly mixed before dispensing. In case of sample **32322**, through a misunderstanding at the time of sale, the druggist explained that the preparation was ⅓ strength which analysis showed it to be.

On the basis of a liberal tolerance, only 75 per cent of the samples examined can be regarded as satisfactory or passable.

Table XI. Analyses of Potassium Iodide.

No.	City or Town	Druggist	Potassium iodide, KI, gms. per 100 cc.	Remarks
32606	*Ansonia*	The Bristol Drug Co. ..	48.15	Pass
32605		McQuade's Drug Store..	34.88	Low
32886	*Bethel*	English Drug Store	41.69	Pass
32855	*Branford*	Williams Drug Store ...	45.25	O. K.
32950	*Bridgeport*	European Pharmacy	47.12	O. K.
32756	*Bristol*	Bristol Pharmacy	45.43	O. K.
32759		Boulevard Pharmacy ..	36.54	Low
32751		Holley's Drug Store ...	42.70	Pass
32896	*Canaan*	Farnum's Drug Store ..	40.62	Low
32897		Freeman Dempsey	42.96	Pass
32451	*Central Village*	Lewis Pharmacy	38.07	Low
32887	*Danbury*	Burn's Drug Store	42.14	Pass
32611	*Derby*	The Purdy Drug Co. ...	46.73	O. K.
32306	*East Hartford*	W. B. Noble	45.98	O. K.
32853	*East Haven*	Metcalf's Drug Store ..	47.71	O. K.
32868	*Fairfield*	Clampett's Pharmacy ...	48.27	Pass
32470	*Greenwich*	The Boswell Drug Co. ..	45.29	O. K.
32340	*Hartford*	G. Fox & Co.	48.78	Pass
32309		Griswold Drug Co.	45.64	O. K.
32766		Richard L. Jeffers	34.03	Low
32336		Lamagreas Pharmacy ..	33.42	Low
32767		H. F. Ruby	44.97	O. K.
32452	*Jewett City*	Chas. R. Carey	49.31	Pass
32977	*Manchester*	E. J. Murphy	37.60	Low

No.	City or Town	Druggist	Potassium iodide, KI, gms. per 100 cc.	Remarks
32974	*So. Manchester*	Miner's Pharmacy	37.35	Low
32602	*Milford*	John T. Howes	45.14	O. K.
32773	*New Britain*	Apothecaries Hall	51.84	Excess
32774		City Drug Store	44.42	O. K.
32477	*New Canaan*	Runyon's Pharmacy	44.22	O. K.
32874	*New London*	James Drug Store	45.53	O. K.
32873		Moon Pharmacy	9.65	Low
32784	*Norwalk*	The Bogardus Drug Store	45.36	O. K.
32787		H. Glendenning & Co. ..	46.07	O. K.
32485	*So. Norwalk*	Plaisted's Drug Store ..	39.69	Low
32328	*Norwich*	Broday Pharmacy	47.64	O. K.
32325		Rachbon's Drug Store ..	49.56	Pass
32319	*Putnam*	Edward H. Bust	42.15	Pass
32322		Farley's Pharmacy	15.66	Pass[1]
32978	*Rockville*	Vincent's Pharmacy	46.27	O. K.
32614	*Seymour*	Geo. Smith & Son	44.24	O. K.
32866	*Southport*	Luin B. Switzer	44.16	O. K.
32995	*Southington*	Chaffee's Drug Store ...	44.92	O. K.
32996		Oxley's Drug Store	40.58	Low
32474	*Stamford*	Chas. S. Finch	49.95	Pass
32498	*Stratford*	W. H. St. John & Co. ...	45.61	O. K.
32453	*Taftville*	Benoit's Pharmacy	41.78	Pass
32964	*Thomaston*	Doyle's Drug Store	44.11	O. K.
32963		G. A. Lemmon	32.42	Low
32315	*Thompsonville*	Steel's Corner Drug Store	49.76	Pass
32622	*Waterbury*	W. J. Dunphy	46.31	O. K.
32617	*Watertown*	D. Y. Sullivan	44.86	O. K.
32790	*Westport*	The Westport Drug Co.	38.99	Low
32490	*Willimantic*	The J. J. Hickey Drug Co.	46.18	O. K.
32316	*Windsor Locks*	R. J. Keef	49.61	Pass
32460	*Winsted*	Bannon's Drug Store ...	46.53	O. K.
32455		The Case Drug Store...	44.85	O. K.

[1] Explanation made at time of sale.

Solution of Arsenous Acid.

Fowler's solution, which is a solution of potassium arsenite, is sometimes dispensed, intentionally or otherwise, for this article. Both contain the same amount of arsenic trioxide (As_2O_3), 0.975 to 1.025 per cent, but they are different substances and the one should not be substituted for the other.

The samples examined are listed in Table XII.

Of the 22 samples obtained 10 were satisfactory, or were passed as substantially of the quality and strength demanded. Two, **32888** and **32783**, were not the article called for; one, **32324**, was twice the strength specified in the prescription; and 9 varied from the required strength by more than 10 per cent. Sample **32461** was not properly mixed, one portion containing 0.44 per cent of arsenic trioxide and the duplicate portion 1.27 per cent.

On the basis of a liberal tolerance, only about one-half of the preparations obtained on this prescription were satisfactory or passable.

TABLE XII. ANALYSES OF ARSENOUS ACID.

No.	City or Town	Dealer	As_2O_3 %	Remarks
32862	*Branford*	The Spalding Co.	0.85	Low
32757	*Bristol*	Leroy P. Tucker	0.55	Low
32889	*Danbury*	Kinner & Benjamin	0.97	O. K.
32888		Simon's Pharmacy	0.97	Fowler's solution
32472	*Greenwich*	Finche's Pharmacy	0.90	Pass
32768	*Hartford*	Snyder's Drug Store	0.91	Pass
32346	*Middletown*	Murphey's Drug Store	0.85	Low
32990	*Mystic*	Wheeler's Drug Store	0.91	Pass
32775	*New Britain*	The Dickenson Drug Co.	0.02	Low
32776		Liggett's Drug Store	0.64	Low
32880	*New London*	The Nichols & Harris Co.	1.00	O. K.
32876		Starr Bros., Inc.	0.98	O. K.
32783	*Norwalk*	McNichols Drug Co., Inc.	0.94	Fowler's solution
32327	*Norwich*	The Lee & Osgood Co.	0.96	Pass
32332		James C. Mara	0.89	Pass
32324	*Putnam*	George E. Dresser	2.05	Excess arsenic
32976	*So. Manchester*	J. H. Quinn & Co.	0.72	Low
32618	*Watertown*	Post Office Drug Store	0.87	Pass
32791	*Westport*	The Bridge Pharmacy	0.52	Low
32494	*Willimantic*	Bay State Drug Co.	0.70	Low
32313	*Windsor*	Robert H. Barnes	0.87	Pass
32461	*Winsted*	Albert Decsi	0.86	Low

AROMATIC SPIRITS OF AMMONIA.

Forty-three samples of this preparation were purchased, largely on prescriptions.

Limits for ammonia and oil contents are not stated in the Pharmacopoeia, but calculated from the formula there given, ammonia (NH_3), should be not less than 1.84 gms. per 100 cc and oils should constitute 1.2 per cent by volume. Ammonia is the essential ingredient, oils of lemon, lavendar and nutmeg being added to impart the aromatic character and make the preparation palatable.

A sample prepared in the laboratory according to the directions given in the Pharmacopoeia showed the following composition:

Sp. Grav. at 25° C.	0.8935
Ammonia (NH_3), gms/100 cc.	1.87
Oils, per cent by volume	1.16
Alcohol, per cent by volume	66.08

Results of the inspection are given in Table XIII. It appears that 25 samples are deficient in ammonia by amounts greater than 10 per cent. There are deficiencies in oil also, but only three of these are considerable.

TABLE XIII. ANALYSES OF AROMATIC SPIRITS OF AMMONIA.

No.	Town	Dealer	Manufacturer	Sp. Gr. at 25° C.	Ammonia gms/100 cc.	Oil % by volume	Alcohol % by volume	Remarks
32858	*Branford*	Branford Pharmacy	Sharp & Dohme	0.8925	1.82	0.96	65.36	Pass
32752	*Bristol*	B. L. Benett	Eastern Drug Co.	0.8970	1.66	1.08	64.56	Pass
32758		The Madden Drug Stores	The Madden Drug Stores.	0.8980	1.32	0.76	63.20	Low in ammonia
32760		Rickman's Drug Store	....	0.9030	1.08	1.08	61.60	Low in ammonia
32993	*Cheshire*	Edson N. Sperry	....	0.8820	1.58	0.92	69.60	Low in ammonia
32473	*Cos Cob*	Mead's Pharmacy	C. W. Whittlesey Co.	0.8930	1.92	1.08	65.76	Pass
32885	*Danbury*	Doran's Drug Store	....	0.8785	1.41	0.84	70.72	Low in ammonia
32601	*Devon*	J. L. Maillard Drug Co.	....	0.8845	0.95	1.00	69.36	Low in ammonia
32307	*East Hartford*	W. B. Noble	Lehn & Fink	0.8970	1.68	1.08	65.20	Pass
32869	*Fairfield*	The Boyle Pharmacy	L. Eisen & Co., Inc.	0.8980	1.73	1.04	63.20	Pass
32867		Randall's Pharmacy	....	0.8890	1.43	1.00	67.36	Low in ammonia
32998	*Guilford*	Frank J. Douden	....	0.9110	1.62	0.84	60.80	Low in ammonia
32310	*Hartford*	G. Fox & Co.	The Belmont Co.	0.8990	1.39	0.92	64.80	Low in ammonia
32311		The Sage-Allen Co.	Brewer & Co.	0.8977	1.62	0.68	66.08	Low in ammonia
32312		Albert Steiger, Inc.	The Sisson Drug Co.	0.8860	1.34	1.08	69.92	Low in ammonia
32997	*Madison*	J. Harrison Monroe	....	0.8930	1.08	0.92	66.00	Low in ammonia
32345	*Middletown*	Lincoln's Drug Store	....	0.8980	1.76	0.92	63.60	Pass
32604	*Milford*	J. H. Barnes	....	0.8930	1.92	1.08	66.80	Pass
32987	*Mystic*	Mystic Pharmacy	....	0.8950	1.55	1.08	65.20	Low in ammonia
31135	*Naugatuck*	Leary's Drug Store	....	0.8960	1.53	0.92	66.40	Low in ammonia
32478	*New Canaan*	Windt Pharmacy	....	0.8920	1.60	1.00	66.80	Low in ammonia
32872	*New London*	Downey's Pharmacy	....	0.9085	2.06	0.96	59.68	Pass
32333	*Norwich*	P. F. Bray	Brewer & Co.	0.8980	1.85	1.24	65.20	Pass
32326		The Lee & Osgood Co.	....	0.9037	1.39	1.08	63.60	Low in ammonia
32621	*Oakville*	Oakville Drug Co.	Bedeser Pharmical Co.	0.9020	1.48	1.00	64.00	Low in ammonia

TABLE XIII. ANALYSES OF AROMATIC SPIRITS OF AMMONIA—*Concluded.*

No.	Town	Dealer	Manufacturer	Sp. Gr. at 25° C.	Ammonia gms/100 cc.	Oil % by volume	Alcohol % by volume	Remarks
33053	*Plainville*	Thrall's Drug Store	....	0.8710	1.19	1.00	73.60	Low in ammonia
32994	*Plantsville*	W. E. Simpson	....	0.8870	1.64	1.00	68.32	Low in ammonia
32979	*Rockville*	Crosby's Pharmacy	Brewer & Co.	0.8935	1.73	1.08	65.20	Pass
32608	*Seymour*	E. J. Barden	....	0.8990	1.48	0.92	64.40	Low in ammonia
32613		Seymour Pharmacy	....	0.8985	1.39	0.92	64.00	Low in ammonia
32609	*Shelton*	Mahoney's Corner Drug Store	....	0.8870	1.70	0.92	68.40	Pass
32975	*So Manchester*	Magnell Drug Co.	Eastern Drug Co.	0.8968	1.88	1.00	64.80	Pass
32482	*So. Norwalk*	Clifford Pharmacy	....	0.8920	1.93	0.92	65.76	Pass
32496	*Stafford Springs*	D. H. McCormack	....	0.8625	1.64	0.92	75.60	Low in ammonia
32495		E. A. Wick's Pharmacy ...	....	0.8990	1.60	0.52	63.20	Low in ammonia
32989	*Stonington*	Burtch Drug Store	Nichols & Harris	0.8960	1.68	1.00	64.56	Pass
32988		J. F. Connors	....	0.9000	1.63	1.00	62.80	Low in ammonia
32499	*Stratford*	Onkey Drug Store, Inc.	....	0.8810	2.11	0.84	65.20	Pass
32317	*Thompsonville*	Thompsonville Drug Co. ...	Gibson-Honen, Inc.	0.8933	1.35	1.16	67.20	Low in ammonia
32462	*Torrington*	Charles D. Goodale	C. W. Whittlesey Co.	0.8905	1.90	0.92	65.92	Pass
32624	*Waterbury*	Liggett's Drug Store	....	0.8980	1.79	1.00	64.80	Pass
31134		South End Drug Store	....	0.8962	1.45	1.00	66.40	Low in ammonia
32314	*Windsor*	Edward Prouty	United Drug Co.	0.8978	1.70	0.68	65.36	Pass

Colloidal Silver Preparations.[1]

Colloidal silver preparations are used in medicine to produce germicidal and antiseptic effects when it is desired to avoid astringency and irritation so far as possible. In general, commercial articles of this class are mixtures of silver, silver oxide and silver-protein, all in colloidal form. The products are classified in several fairly well-defined groups, only two of which need be mentioned here, viz., Protargin Mild or the Argyrol type, and Protargin Strong or Protargol type. Each of these groups is represented by a number of commercial products many of which are patented or otherwise protected. So far as experimental or clinical evidence is concerned, there appear to be no significant differences in the therapeutic effects produced by the various preparations of the respective groups. There are, however, considerable differences in the prices charged for these products; thus argyrol, which is perhaps the best known, costs $1.50 per ounce while some of the silver preparations of the same type cost only one-half as much. It has been alleged among druggists that substitution of the cheaper articles for those of higher price is prevalent in retail practice, and the analytical evidence hereinafter given shows that such is the case. There is, however, some reason to believe that the name argyrol has acquired a generic sense; in other words, that the name is associated with, and used to designate, a type of silver preparation rather than a particular brand thereof. Nevertheless, if a physician prescribes argyrol it must be presumed that he wants that particular article; and if protargin mild of some other make and of lower price is supplied, as, and at the price of, the article demanded, the substitute article is technically misbranded and the retailer has profited unduly at the expense of his customer.

As a preliminary to the examination of argyrol and protargol solutions as retailed by druggists, a number of the commercial brands of each type were purchased and examined in 10 per cent and 2 per cent solutions respectively. The results are given in the following tabulation. (Table XIV.)

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[1] For fuller discussion of these preparations see New and Non-official Remedies, 1924, p. 337. Jour. Am. Med. Assoc.; also Jour. Am. Pharm. Assoc., 7, 677. 1918.

TABLE XIV. PRELIMINARY ANALYSES OF SILVER-PROTEIN PREPARATIONS.

No.	Brand and Manufacturer	Solids, gms. per 100 cc.	Ash, gms. per 100 cc.	Silver, gms. per 100 cc.	Nitrogen, gms. per 100 cc.	Ratios Ash / Silver	Ratios Nitrogen / Silver
	Prepared in Laboratory.						
	Protargin Mild, 10% solution.						
2651	Argyrol (Barnes)	9.26	3.43	1.97	0.82	1.74	0.42
3208	Argyn (Abbott)	9.21	3.15	2.41	1.02	1.31	0.42
3211	Cargentos (Mulford)	9.10	3.51	2.09	0.84	1.67	0.40
3209	Solargentum (Squibb)	9.63	2.82	1.96	1.21	1.44	0.62
3210	Vargol (Heyden)	9.38	2.72	1.93	1.19	1.40	0.62
	Protargin Strong, 2% solution.						
2634	Protargol (Winthrop)	1.79	0.22	0.15	0.24	1.47	1.60
3207	Protargentum (Squibb)	1.84	0.26	0.16	0.28	1.62	1.75
3206	Proganol (Heyden)	1.84	0.44	0.17	0.19	2.60	1.12
	Purchased from Druggists.						
2632	Argyrol 10% solution	10.47	3.98	2.19	0.92	1.81	0.42
2633	" " "	6.59	2.44	1.38	0.58	1.77	0.42
2652	" " "	8.95	3.36	1.92	0.78	1.75	0.41
2653	" " "	9.38	3.55	1.98	0.84	1.79	0.42
2654	" " "	10.87	3.01	2.36	1.48	1.28	0.63
2655	" " "	8.43	3.15	1.75	0.77	1.80	0.44
2656	" " "	6.43	2.42	1.21	0.57	2.00	0.47
2657	" " "	8.53	3.23	1.83	0.75	1.77	0.41

Protargin mild should contain from 19 to 25 per cent of silver (metallic); and protargin strong should contain from 7.0 to 8.5 per cent of silver (metallic).[1] A ten per cent solution (10 grams in sufficient water to make 100 cc) of protargin mild should contain not less than 1.90 gms. of silver per 100cc and a two per cent solution of protargin strong should contain not less than 0.14 gm. of silver per 100 cc.

From the data given in Table XIV it appears that the silver content of samples of both types of silver-proteins are within the requirements for the respective groups; and that some of the commercial solutions of argyrol were deficient in this respect. Moreover, while the experimental results are based upon only one sample of each of the commercial brands cited, nevertheless the ratios of ash : silver and of nitrogen : silver suggest a basis for some conclusions as to the identity of products within the respective groups. Thus, considering these ratios jointly, Argyn is differentiated from the other four. In the instances of Solargentum and Vargol, the values of these ratios are very different from those of Cargentos and Argyrol; but as between the individuals of either pair, however, the ratios show no conspicuous distinction. Similarly in the protargol group there are certain differences which are significant. It is evident that these ratios depend chiefly upon the character of the protein material used in the manufacture of the several products. Gelatin, albumin, casein and so-called "denatured" proteins are employed.

ARGYROL.

In Table XV are given the analyses of the official samples collected by the Dairy and Food Commissioner, the inspector calling for a 10% solution of argyrol. From these data the following summary can be made.

Of 59 official samples given in Table XV, 46 show ratios for ash : silver and nitrogen : silver which are closely in accord with those found for argyrol, and these samples are, therefore, presumed to be the article called for, or a silver-protein having similar constants.

In thirteen samples the ratios mentioned are widely different in magnitude from those determined for argyrol. The following summaries show the data upon which these conclusions are based.

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[1] Limits as given in New and Non-official Remedies. The U. S. P. gives for protargin-strong 7.5 to 8.5 per cent of silver (metallic).

	Ash	Silver	Nitrogen	Ash / Silver	Nitrogen / Silver	Retail price of article, cents per oz.
Passed as argyrol.						
Maximum	4.52	2.57	1.10	1.84	0.45	45
Minimum	2.14	1.19	0.51	1.68	0.39	25
Average	3.40	1.92	0.81	1.77	0.42	31
Not argyrol.						
Maximum	3.16	2.33	1.40	1.64	0.68	63
Minimum	1.27	1.02	0.62	1.25	0.52	23
Average	2.50	1.85	1.11	1.35	0.60	34
Known Solution.						
Argyrol	3.43	1.97	0.82	1.74	0.42	..

It will be noted that the retail price per ounce for the argyrol and non-argyrol samples averages about the same. If two samples are excluded from the non-argyrol group the price range is 23 to 45 cents which would make the range and the averages practically identical for the two groups.

PROTARGOL.

Of the 17 samples collected on request for a 2% solution of protargol, analyses of which are given in Table XV, the ash : silver and nitrogen : silver ratios in five cases vary widely from the values obtained on the experimental sample of protargol in 2% solution. Whether the others are protargol or some product having similar constants, protargentum for example, is not satisfactorily shown. The basis for these conclusions is found in the following data.

	Ash	Silver	Nitrogen	Ash / Silver	Nitrogen / Silver	Retail price of solution, cents per oz.
Passed as Protargol.						
Maximum	0.34	0.20	0.33	1.70	1.80	33
Minimum	0.18	0.13	0.22	1.40	1.41	14
Average	0.26	0.16	0.27	1.59	1.64	21
Not Protargol, or doubtful.						
Maximum	0.37	0.17	0.28	2.64	2.00	38
Minimum	0.06	0.04	0.05	1.10	1.25	23
Average	0.22	0.12	0.20	1.82	1.59	29
Known Solution.						
Protargol	0.22	0.15	0.24	1.47	1.60	..

SUMMARY.

The entire inspection of silver-protein preparations may be summarized as follows:

ARGYROL.

Number of official samples sold as argyrol	59
Number of samples below standard	9
Number of samples below standard and technically misbranded	3
Number of samples technically misbranded	10
Number of samples passed	37.

The samples which are below standard in silver are as follows:

		Silver, gms./100 cc.
31147	G. Fox & Co., Hartford	1.64
31149	Apothecaries Hall, New Haven	1.31
32302	W. H. Wood, New Haven	1.66
32304	York Pharmacy, New Haven	1.31
32458	Apothecaries Hall, Winsted	1.64
32476	Jas. J. Cody, New Canaan	1.49
32480	W. H. Jones Drug Store, Stamford	1.49
32488	T. P. Gillespie & Co., New Haven	1.19
32620	Picarrelli Pharmacy, Inc., Waterbury	1.60

The samples which are below standard and technically misbranded are as follows:

		Silver found gms./100 cc.	Ash / Silver	Nitrogen / Silver
31137	E. J. Sodolosky, Union City	1.02	1.25	0.61
32303	Chas. T. Hall, New Haven	1.61	1.34	0.52
32808	Park Pharmacy, Middletown	1.26	1.33	0.61

The samples which are technically misbranded are as follows:

		Ash / Silver	Nitrogen / Silver
31133	Picarrelli Pharmacy, Inc., Waterbury	1.41	0.57
32301	T. P. Gillespie & Co., New Haven	1.29	0.61
32331	H. M. Lerou, Norwich	1.27	0.65
32338	Lamagreas Pharmacy, Hartford	1.26	0.68
32341	Misentis Drug Store, Middletown	1.39	0.57
32479	A. L. Embree, Stamford	1.28	0.58
32347	Hartman Drug Co., Middletown	1.64	0.54
32600	Botsford's Drug Store, Milford	1.44	0.62
32619	Apothecaries Hall, Waterbury	1.31	0.61
32881	E. J. Sodolosky, Union City	1.35	0.60

PROTARGOL.

Number of official samples sold as protargol	17
Number of samples below standard in silver and technically misbranded	2
Number of samples technically misbranded or doubtful	3
Number of samples passed	12

The two samples which are below standard and also technically misbranded are as follows:

		Silver, gms./100 cc.	Ash / Silver	Nitrogen / Silver
31136	E. J. Sodolosky, Union City	0.04	1.50	1.25
32475	McMahon's Pharmacy, Stamford	0.09	2.00	2.00

The samples which are technically misbranded or doubtful are as follows:

		Ash / Silver	Nitrogen / Silver
32469	D. H. McHugh, E. Portchester	2.64	1.64
31132	Buckingham Pharmacy, Waterbury	1.10	1.65
32497	Windham Pharmacy, Willimantic	1.88	1.41

TABLE XV. ANALYSES OF SILVER-PROTEIN SOLUTIONS.

No.	Town	Name	Total solids gms./100 cc.	Ash gms./100 cc.	Silver gms./100 cc.	Nitrogen gms./100 cc.	Ash / Silver	Nitrogen / Silver	Retail price, cents per oz.
		Argyrol, 10% solution.							
349	*Danielson*	Borrough's Drug Store	9.13	3.37	1.95	0.79	1.73	0.41	30
150		Woodward's Drug Store	11.13	4.14	2.33	0.96	1.78	0.41	25
[illegible]12	*Derby*	The Harding Drug Store	10.06	3.72	2.09	0.91	1.78	0.44	38
171	*Greenwich*	Greenwich Drug Store, Inc.	9.31	3.53	1.92	0.83	1.84	0.43	33
339	*Hartford*	Eddie's Pharmacy	10.62	3.93	2.19	0.94	1.79	0.43	33
147		G. Fox & Co.	7.83	2.96	1.64	0.66	1.80	0.40	30
338		Lamagreas Pharmacy	10.04	2.50	1.99	1.35	1.26	0.68	23
145		Lester's Pharmacy	8.25	3.10	1.72	0.72	1.80	0.42	30
146		Louis K. Liggett Co.	9.33	3.44	1.97	0.80	1.75	0.41	33
308		O'Connell Drug Co.	9.22	3.48	2.00	0.79	1.74	0.40	25
318		Wise Smith & Co.	11.41	3.57	2.01	0.91	1.77	0.45	35
348	*Meriden*	Victor W. Schmelzer	9.90	3.64	2.04	0.87	1.78	0.43	30
343	*Middletown*	John J. Cronin	8.98	3.30	1.86	0.79	1.77	0.42	45
347		The Hartman Drug Co.	9.08	3.16	1.93	1.05	1.64	0.54	45
341		Misentis Drug Store	8.45	2.55	1.83	1.04	1.39	0.57	25
808		Park Pharmacy	5.95	1.68	1.26	0.77	1.33	0.61	38
342		C. A. Pelton	8.80	3.26	1.83	0.77	1.78	0.42	33
600	*Milford*	Botsford's Drug Store	9.34	2.73	1.90	1.17	1.44	0.62	63
603		Milford Pharmacy	10.16	3.78	2.14	0.89	1.77	0.42	35
777	*New Britain*	The Brooks Drug Co.	9.74	3.62	2.08	0.87	1.74	0.42	43
476	*New Canaan*	James J. Cody	7.06	2.61	1.49	0.63	1.75	0.42	45
149	*New Haven*	Apothecaries Hall	6.22	2.30	1.31	0.55	1.76	0.42	33
130		De Vita Pharmacy	9.64	3.60	2.00	0.85	1.80	0.43	25
301		T. P. Gillespie & Co.	9.82	2.67	2.07	1.27	1.29	0.61	50
488		T. P. Gillespie & Co.	5.98	2.14	1.19	0.54	1.80	0.45	30
305		The Hall-Benedict Co.	8.59	3.26	1.82	0.73	1.79	0.40	53

TABLE XV. ANALYSES OF SILVER-PROTEIN SOLUTIONS—*Continued.*

No.	Town	Name	Total solids gms./100 cc.	Ash gms./100 cc.	Silver gms./100 cc.	Nitrogen gms./100 cc.	Ash / Silver	Nitrogen / Silver	Retail price, cents per oz.
		Argyrol, 10% solution—Con.							
32303	*New Haven*	Chas. T. Hull	7.01	2.17	1.61	0.84	1.34	0.52	30
32981		Chas. T. Hull	12.43	4.69	2.66	1.12	1.77	0.42	45
32300		Liggett's Drug Store	9.23	3.32	1.91	0.83	1.74	0.43	33
31131		Volpes Pharmacy	8.93	3.37	1.86	0.78	1.81	0.42	25
31148		Wood's Drug Store	9.44	3.52	1.99	0.81	1.77	0.41	40
32302		W. H. Wood	7.79	2.92	1.66	0.67	1.76	0.40	33
32304		York Pharmacy	6.01	2.25	1.31	0.51	1.72	0.39	25
32329	*Norwich*	Broadway Pharmacy	8.88	3.16	1.76	0.80	1.80	0.45	25
32331		H. M. Lerow	11.34	2.93	2.30	1.50	1.27	0.65	25
32320	*Putnam*	W. B. Carroll	9.46	3.53	1.98	0.83	1.78	0.42	33
32323		J. A. P. Gagne	9.80	3.63	2.03	0.86	1.79	0.42	38
32610	*Shelton*	Shelton Pharmacy	9.92	3.68	2.06	0.90	1.79	0.44	25
32483	*So. Norwalk*	Stillson-Powell Corp.	11.06	4.05	2.34	0.99	1.73	0.42	30
32479	*Stamford*	A. L. Embree	9.23	2.62	2.05	1.19	1.28	0.58	25
32480		The W. L. Jones Drug Store	7.52	2.80	1.49	0.65	1.88	0.44	25
32454	*Taftville*	Taftville Pharmacy	10.07	3.79	2.10	0.87	1.80	0.41	33
32465	*Torrington*	Claxton's Pharmacy	10.25	3.80	2.10	0.90	1.81	0.43	33
32463		Opperman's Drug Store	9.07	3.36	1.88	0.81	1.79	0.43	30
32468		Park Pharmacy	9.12	3.42	1.90	0.78	1.80	0.41	38
32467		South End Pharmacy	9.23	3.38	1.96	0.81	1.72	0.41	43
31137	*Union City*	E. J. Sodolosky	4.80	1.27	1.02	0.62	1.25	0.61	33
32881		E. J. Sodolosky	9.58	2.76	2.05	1.22	1.35	0.60	23
32486	*Wallingford*	Moran's Drug Store	9.55	3.49	1.96	0.85	1.78	0.43	30
32619	*Waterbury*	Apothecaries Hall Co.	10.98	3.06	2.33	1.41	1.31	0.61	33
32623		E. H. Georgia	9.78	3.67	2.18	0.92	1.68	0.42	33
31133		Picarelli Pharmacy, Inc.	8.10	2.44	1.73	0.98	1.41	0.57	30
32620		Picarelli Pharmacy, Inc.	7.80	2.87	1.60	0.70	1.79	0.44	21

TABLE XV. ANALYSES OF SILVER-PROTEIN SOLUTIONS—*Concluded.*

No.	Town	Name	Total solids gms./100 cc.	Ash gms./100 cc.	Silver gms./100 cc.	Nitrogen gms./100 cc.	Ash / Silver	Nitrogen / Silver	Retail price, cents per oz.
		Argyrol, 10% solution—Concluded.							
31141	*Whitneyville*	Country Club Pharmacy	8.44	3.12	1.81	0.73	1.72	0.40	25
32492	*Willimantic*	Curran & Flynn	9.20	3.39	1.96	0.80	1.73	0.41	38
32489		The Vigeard Pharmacy	9.66	3.62	2.06	0.84	1.76	0.41	33
32458	*Winsted*	Apothecaries Hall Co.	7.70	2.87	1.64	0.67	1.75	0.41	35
32459		Frank L. Bunnell	12.33	4.52	2.57	1.10	1.76	0.43	25
32456		The City Pharmacy	9.00	3.36	1.89	0.82	1.78	0.43	25
		Protargol, 2% solution.							
32607	*Ansonia*	Buckley's Pharmacy	1.69	0.22	0.13	0.22	1.70	1.70	20
32469	*E. Port Chester*	D. H. McHugh	1.78	0.37	0.14	0.23	2.64	1.64	23
32337	*Hartford*	Lamagreas Pharmacy	1.88	0.30	0.18	0.28	1.67	1.56	33
32344	*Middletown*	United Chemists	1.55	0.18	0.13	0.22	1.40	1.70	25
32330	*Norwich*	Smith's Drug Store	1.88	0.26	0.16	0.27	1.62	1.70	15
32484	*So. Norwalk*	H. A. Mead	1.58	0.22	0.13	0.22	1.70	1.70	20
32481	*Stamford*	Ferguson's Pharmacy	1.95	0.27	0.17	0.27	1.59	1.59	25
32475		McMahon's Pharmacy	1.26	0.18	0.09	0.18	2.00	2.00	25
31136	*Union City*	E. J. Sodolosky	0.42	0.06	0.04	0.05	1.50	1.25	18
32615		E. J. Sodolosky	1.76	0.22	0.15	0.25	1.47	1.67	14
32464	*Torrington*	Collins & Collins	2.24	0.34	0.20	0.33	1.70	1.65	15
32466		Thurlough's Pharmacy	2.29	0.30	0.19	0.30	1.58	1.58	15
32487	*Wallingford*	F. W. Marx	2.36	0.29	0.19	0.28	1.53	1.47	18
31132	*Waterbury*	Buckingham Pharmacy	1.80	0.19	0.17	0.28	1.10	1.65	38
32493	*Willimantic*	Chas. deVillers	1.79	0.24	0.15	0.27	1.60	1.80	30
32491		The Wilson Drug Co.	1.97	0.26	0.17	0.27	1.53	1.60	25
32497		Windham Pharmacy	1.78	0.32	0.17	0.24	1.88	1.41	25

Proprietary Remedies, etc.

GADUOL.[1]

Modifications of cod liver oil, purporting to contain the therapeutic constituents of the oil, have long been offered as proprietary medicines. Some of these have been discussed in a previous report[2] of this laboratory. Because of the demonstrated worth of cod liver oil as a preventative and curative agent for certain nutritional disorders a new interest attaches to preparations of this oil which express or imply vitamine A potency.

Recently a product called "Gaduol" has been subjected to actual feeding tests in comparison with cod liver oil, of ordinary commercial grade; and the biological tests were supplemented with partial chemical analysis of the product. Gaduol is made by, or prepared for, Merck and Co., and is labeled merely as an "alcohol-soluble extract of cod liver oil." Its chief use is apparently as a basis for Wine of Gaduol, but it may have other uses, such, for example, as an ingredient of cod liver oil pills or tablets. No claims are made as to the relative potency of the extract as compared with cod liver oil, but such a comparison at once suggests itself as a matter of interest.

Gaduol is a dark brown, semisolid preparation with a strong fishy odor. Partial analyses of the two samples[3] examined are as follows:

	No. 2547 %	No. 2677 %
Moisture (in vacuum over H_2SO_4 room temp.)	4.73	3.09
Ash	0.92	2.02
Nitrogen	1.38	2.69
Fat (petroleum ether extract)	89.90	77.20

The second sample, **2677**, contains twice as much mineral matter and nitrogeneous material as the first, and distinctly less ether-soluble substances. Recently Epstein and Harris[4] have analyzed an alcohol extract which is typical of gaduol and found 3.18 per cent of total nitrogen with about 65 per cent of free fatty acids and saponifiable fat, and 30 per cent unsaponifiable matter.

From this it appears that considerable variations in chemical composition may be found in different lots or batches of the product.

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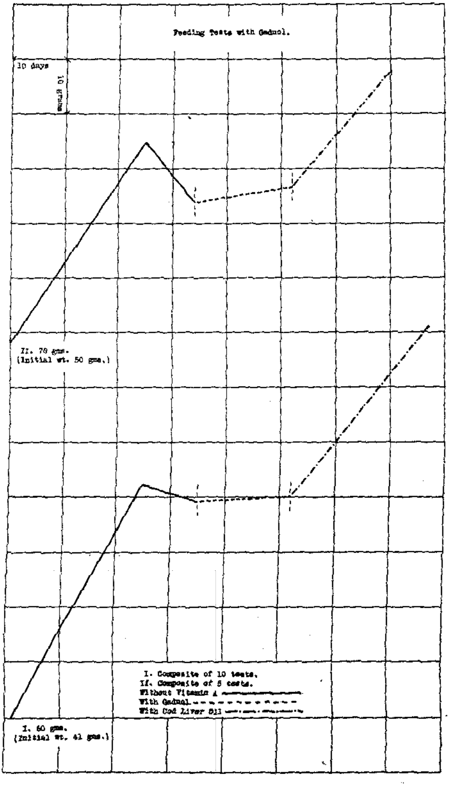
[1] The writer gratefully acknowledges the coöperation of Miss Helen Cannon in connection with the biological tests required in the examination of this product.

[2] Conn. Exp. Station Report of 1914, Part V.

[3] One sample was furnished by courtesy of the Bureau of Chemistry, U. S. Dept. of Agriculture. The other was purchased by the Station locally.

[4] J. Am. Pharm. Assoc., 14, 7, 590.


Feeding Tests with Gadnol.
10 days
10 grams
II. 78 gms.
(Initial wt. 50 gms.)
I. Composite of 10 tests.
II. Composite of 5 tests.
Without Vitamin A
With Gadnol
With Cod Liver Oil
I. 60 gms.
(Initial wt. 41 gms.)

For feeding purposes the well-mixed sample was triturated with starch or yeast powder and the mass rolled into pills. Each pill contained 100 mgms. of gaduol and 200 mgms. of starch or yeast powder. Batches of pills were made at frequent intervals to insure freshness. When the gaduol-yeast mixture was fed, separate yeast rations were unnecessary as each pill contained the daily dosage of yeast ordinarily fed, viz., 200 mgms. The amounts of cod liver oil fed in the recovery (control) period were from one to five drops unmixed. Since the weight of 1 drop of oil was determined to be about 16 mgms., the comparisons are between 100 mgms. of gaduol and from 16 to 80 mgms. of cod liver oil.

The trials were made in two series, ten animals being fed with sample **2547** and five with **2677**. The individual growth curves are not shown, but for each series a resultant curve has been constructed which represents the average of results obtained in the feeding tests. These two curves are shown in the accompanying chart. The curves have been constructed on the basis of the following information:

1 Average of initial weights of animals.
2 Average duration of foreperiod.
3 Average duration of decline preceding foreperiod.
4 Average decline in weight during this period (3).
5 Average weight at beginning of experimental period.
6 Average duration of experimental (gaduol), period.
7 Average gain or loss during experimental period.
8 Average duration of recovery (cod liver oil), period.
9 Average gain during recovery period.

The balancing of gains against losses during the experimental periods results in each series in a slight net increase in weight. The true significance of this is that in some instances considerable gains in weight were made during the early part of the gaduol feeding period, but these gains were not sustained and cod liver oil was substituted for gaduol because of the serious rate of decline, or of other unfavorable symptoms, although body weights were not necessarily below these found at the beginning of the experimental feeding.

Experimental periods were made as long as possible, but in many cases, although body weights did not decline, the animals became so weakened, or the eye conditions became so aggravated, that changes were made to cod liver oil to avoid permanent injury or death of the animals.

During the periods of gaduol feeding the hemorrhagic condition of the eyes became aggravated in some cases and in others temporary improvement was noted. What appeared to be a permanent clearing of the eyes was noted in only one case but in this instance the symptoms were not very marked at any time. During the

recovery period normal eye conditions were restored except in two cases where the injury (plaques) sustained during gaduol feeding was of a permanent character.

The tests on the whole show that, from the standpoint of Vitamine A potency, gaduol is distinctly inferior to the straight cod-liver oil used as a control.

1545 and D. C. **30590**. *Chief Two Moon Bitter Oil.* The Chief Two Moon Herb Co., Waterbury, Conn. This preparation is described as "the wonder laxative tonic." No curative claims are made for the product; but in accompanying literature it is stated that the medicine, by keeping the organs of the body in good condition, defends against rheumatism, pneumonia, tuberculosis, and a number of other ailments. This language is fairly conservative, but the mention of specific diseases, especially tuberculosis, is objectionable.

The preparation was found to consist of about 95 per cent of mineral oil and 5 per cent of dilute alcoholic solution of vegetable bitters, chiefly aloes. On the basis of the entire mixture the amount of alcohol present was about 1 per cent. The medicine is essentially a laxative with probably some tonic properties due to the bitters.

Toilet Preparations.

Four samples of alcohol for massage purposes were examined. They were all specially denatured products and passed. The denaturants found were those approved for this type of products and were diethylphthalate, isopropyl alcohol, benzol, acetone, salicylates, and zinc, the latter presumably being present as zinc sulfocarbolate. No wood alcohol was found.

Turpentine.

Section 2501 of the General Statutes provides that no article shall be sold as "turpentine" or "spirits of turpentine" which is not wholly distilled from rosin, turpentine gum or scrapings from pine trees, and unmixed and unadulterated with oil, benzine or any other substance, unless the package containing the same shall be labelled "adulterated spirits of turpentine."

Twenty-two samples were examined for the Dairy and Food Commissioner. In the examination and judgment of the samples the specifications suggested by the U. S. government[1] have been followed.

Among these specifications are the following:

Specific gravity at 15.5° C.	0.875-0.862
Refractive index at 20° C.	1.478-1.468
Unpolymerized residue, per cent by volume, not over	2.5
Distilling below 170° C., per cent not less than	90.00

[1] U. S. Dept. Agr. Bult. 898, Nov. 1920.

The product must be clear and free from suspended matter and water; and the color shall not exceed the shade known as "standard" as measured by the Lovibond colorimeter.

The samples examined were in all cases clear, excepting **33094**, which was turbid. They were also colorless or nearly colorless. The intensity of color was not exactly measured. The specific gravities were within the limits of the specifications given except in three cases which were explained by the probability of exposure of the samples before this determination was made. (Samples which had shown normal specific gravities were found to have increased appreciably on later examination.) The unpolymerized residues, which indicate mineral oil adulterants, were negligible, or within the limit set by the specifications, except in **33089** and **33225** where the amounts found were 6.8 and 8.4 per cent; and in **33094** and **33224** which samples were largely mineral oil. In the two last named samples only about 20 per cent distilled below 170° C. In all other samples substantially 90 per cent or more distilled below 170° C.

Of the twenty-two samples, therefore, only four failed to conform to the essential requirements for pure turpentine. These four are as follows:

No.		Dealer	Manufacturer
33094 33224	*Bristol*	M. H. Herbert	?
33089 33225	*New Britain*	O'Connor Drug Store	D. A. Rosan, Hartford

A summary of the data on samples which were passed is as follows:

	Maximum	Minimum
Specific gravity[1] at 20° C.	0.8787	0.8644
Refractive index at 20° C.	1.4770	1.4700
Unpolymerized residue, per cent	1.2	none
Distillation, 90 per cent at	168.9° C.	151.3° C.

[1] *Excluding three results probably unreliable for the reason stated in the discussion.*

MISCELLANEOUS.

Miscellaneous materials, twenty-two in number, including samples examined for poisons, have been submitted by health officers or other public officials. The examinations made are summarized in Table XVI.

TABLE XVI. MISCELLANEOUS DRUGS, ETC.

No.	Name of material	Remarks
2490	*Cakes and candy*	*Examined for concealed drugs. No chemical analysis was made, but careful inspection revealed nothing suspicious.*
2093	*Liver of cow*	*No poison found.*

3203	*Medicine*	Said to be a preparation of seaweed. Total iodine found 0.69%, practically all soluble in water and liberated completely from acid solution by ferric alum. The iodine is, therefore, probably all in inorganic combination.
32397	*Ointment*	Dark brown ointment with odor of creosote. Found to consist of a petrolatum base with zinc oxide as the chief medicament determined. Creosote and other vegetable principles were indicated. No salicylates, benzoates or resins were found.
942	*Poisoned bait*	Meat, apparently liver, showed an incision in which was found fragments of a wax ampule. No characteristic odor was noted in the meat as received. Cyanide was detected by reliable tests.
1439	*Prescription*	Powders, each supposed to contain codeine sulphate 12/100 grain, sodium salicylate 19.3 grains, ammonium bromide 19.3 grains. Found codeine sulphate 15/100 grain, sodium salicylate 19.9 grains, ammonium bromide 21.5 grains. Free salicylic acid 29/100 grain. Powders substantially as claimed.
2864	*Stomach contents (calf)*	Arsenic found. No lead or other heavy metals detected.
2523	*Stomach contents (cow)*	Both copper and arsenic were found, suggesting Paris green as the cause of death.
1205	*Toilet lotion*	Alleged to have been used for drinking purposes. Contained approximately 7% alcohol. No cocaine or opiates present.
2756	*Unknown liquid*	Found to be a 28% solution of calcium chloride.
1412	*Unknown powder*	Found to be citric acid, partly effloresced.
1206	*Viscera of fox*	Stomach contained a small amount of grain and much of what appeared to be rabbit hair. Strychnine was found in small amount. Evidence suggested use of poisoned rabbits for bait.
2621	*Viscera of pigeon*	No mineral poison found.
2491	*Water*	To identify sediment. Found to be largely or entirely iron.
2451	*Water*	Water from melting ice in fish carts. Examined for salt and found to contain only a trace, 0.02%.
2338	*Wall paper*	Tested for arsenic. None was found. (The laws of some States limit arsenic [As] to 0.1 grain per sq. yd.)

Five samples of oils and one of gasoline were examined upon which no particular comment is required.

Whiskey.

About 20 years ago one of the vexed questions arising in connection with the enforcement of the Food and Drugs Act was "What is Whiskey?" After much debate and controversy a very simple official conclusion was reached which was, in effect, that the commodity which was then, and which has been for many years, commonly known and accepted in the trade and among consumers as whiskey, was whiskey. This interpretation did not limit the name to that product aged in wood whereby the aroma and flavor for which whiskey is prized are acquired; nor did it make the natural color developed by the aging process an essential. Thus, factitious whiskeys made largely, or in part, from mixtures of grain alcohol, caramel, beading oil and artificial flavor were widely sold as, and for, whiskey long before prohibition became operative.

Presumably under the influence of the Volstead Act, whiskey and brandy, which had hitherto been recognized as medicinal agents and included in the United States Pharmacopoeia, were omitted in the ninth revision of that text. But, in view of the fact that both of these commodities are legitimately obtainable under proper restrictions, it would be unfortunate if there were no official specifications for their substance and quality, and in the present (tenth) revision of the Pharmacopoeia these two products are again recognized.

The dangerous character of present day liquors in general, and of whiskey in particular, is a widely accepted opinion based, for the most part, upon frequent comment and criticism in the press and periodicals of the country. The serious symptoms which accompany intoxication, or the deaths which follow it, are generally alleged to be due to "poisoned rum," but seldom are the allegations supported by adequate, acceptable evidence as to what is the poisonous principle or constituent. Those who have had the most experience in the examination of bootleg liquor are more conservative in their conclusions. Thus, as one state chemist of wide experience says, "the most poisonous constituent of alcoholic liquors is the alcohol which they contain." In our own experience, aside from a series of samples in which wood alcohol has been substituted for grain alcohol and all of which were traced to one source, we have identified no foreign substance in bootleg liquor of the types ordinarily used as beverages, which in kind or amount could be regarded as a probable cause of death. There is substantial analytical and other evidence to show that much of the alcohol used in preparation of present day liquors is obtained by the rectification

of denatured alcohol, particularly the specially denatured type. Such alcohol generally shows on analysis traces of denaturants which have carried over in the process of purification. What the physiological effects, cumulative or otherwise, of these small amounts of denaturants may be is speculative, but we are aware of no authoritative opinion that traces of such substances as diethylphthalate, isopropyl alcohol, benzol and acetone are likely to produce measurable effects of a dangerous character. However, with the evidence that much of the alcohol found in intoxicating liquors is derived from the denatured article, there is always the possibility of inefficient purification and hence such liquors constitute a potential source of danger.

Whiskey has never been entirely free from suspicion as to its quality. It was, indeed, upon representations of its dangerous character that bar whiskey of the cheaper sorts was examined in this laboratory about ten years ago. The following comment may be quoted from our report of 1915.

"It has been suggested that the sudden evil effect of certain bar whiskies on the users indicated that some harmful ingredient other than alcohol might be present, such as wood alcohol, ether or chloral hydrate. The present examination was undertaken, therefore, to determine the alcoholic content of bar whiskey, and the presence or absence of these foreign poisons. In the present state of official opinion it appeared futile to indulge in the niceties of a real whiskey analysis.

One hundred and twenty-three samples were analyzed, in most cases representing the cheapest grades of whiskey sold in our larger cities. In 15 of the samples wood alcohol was suspected from the differences between the actual and theoretical readings of the distillates as shown by the immersion refractometer. The most careful tests, however, failed to demonstrate the presence of wood alcohol in any case, other than possibly mere traces. Likewise neither ether nor chloral was found in any of the samples."

The samples which represent the period 1920-25[1] are such as have been submitted by police or prohibition enforcement officials in connection with the enforcement of our State liquor laws and include also a few submitted by Federal agents. A comparison of some of the essential features of "whiskey" as obtained in these two periods is of interest in connection with some of the comments which have appeared from time to time upon the character of the present day article.

ALCOHOLIC CONTENT.

The alleged pernicious effects of present day liquor have been explained as in part due to a greater alcoholic content than was formerly the case. The following summary throws light upon this point.

[1] Practically all of these samples were examined by Mr. Andrew who also has made, from time to time, critical studies of methods for the detection of denaturants.

	1915	6 yr. period 1920-25
Number of samples	123	274
Samples containing less than 30% alcohol	3	9
Maximum alcohol content	52.85%	59.60%
Minimum alcohol content	21.91%	16.40%
Average alcohol content	42.19%	42.40%

So far as whiskey is concerned, it does not appear that the bootlegger is any more generous with his alcohol than was the saloonkeeper of old.

SOLIDS.

According to official specifications, whiskey, when evaporated and the residue dried at 100° C., should not contain more than 0.5 gram of solids per 100cc.

In 1915 the range of solids in the 123 samples examined was 0.08 to 0.99 excluding two samples which contained 12 and 20 per cent of sugar respectively. The samples in the 6 year period already mentioned showed from 0.01 to 2.48 gms. per 100 cc excluding one sample which contained about 20 per cent of sugar. The average content of solids in 1915 was 0.53 as compared with an average of 0.38 for the later period.

COLOR.

The color of official whiskey should be that derived from the charred casks in which it is stored. Such color is largely or entirely soluble in amyl alcohol acidified with phosphoric acid (Marsh reagent). If the color is insoluble in this reagent, artificial color is indicated.

In 1915 only 13 of the 123 samples examined were regarded as being probably genuine with respect to color. In the remaining samples from 10 to 98 per cent of the color was insoluble in acidified amyl alcohol.

So far as whiskey of the later period has been examined in this particular, of 90 samples only 7 appeared to be of natural color. In the remaining samples caramel was found and in one case a coal tar color also. The proportion of naturally colored products found in the two periods is only about 10 per cent of the total in each case. In other words, artificially colored whiskey was about as prevalent before prohibition as it is now.

ODOR AND TASTE OF RESIDUE ON EVAPORATION.

The residue left after evaporating whiskey has a characteristic aromatic odor, a slightly astringent taste but is not distinctly sweet or bitter.

Of 78 samples recently tested only 6 appeared to be of a genuine character.

DENATURANTS.

Sixty samples were examined for traces of denaturants and in 26 samples positive tests for diethylphthalate were obtained and in one isopropyl alcohol was detected. Thus in nearly one-half of the samples tested the alcohol appears to have been derived wholly, or in part, from denatured alcohol. In no case was wood alcohol found.

CONCLUSIONS.

Insofar as the analytical data which forms the basis of this discussion can reflect the quality of whiskey for the two periods noted, it appears that the only significant difference between them is the presence of denaturants in the present day product, due to the source from which the alcohol is derived. As already pointed out, the possibility of clumsy manipulation of denatured alcohol in order to make it fit for beverage purposes constitutes a menace to health which cannot be ignored. This applies not only to whiskey but to similar liquors, e. g. gin, brandy, and cordials, of high alcoholic content, all of which may be produced factitiously.

III. BABCOCK GLASSWARE.

Three thousand, eight hundred and twenty-six pieces of Babcock glassware were examined in the calendar year of 1925, of which number only four pieces were rejected as inaccurate.

Bulletin 277 April, 1926

Connecticut Agricultural Experiment Station
New Haven, Connecticut

REPORT ON INSPECTION

OF

COMMERCIAL FEEDING STUFFS

1925

The Bulletins of this Station are mailed free to citizens of Connecticut who apply for them, and to other applicants as far as the editions permit.

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as of

April, 1926

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THE TUTTLE, MOREHOUSE & TAYLOR COMPANY

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COMMERCIAL FEEDING STUFFS

E. M. BAILEY.*

THE FEED LAW.

The law relating to concentrated commercial feeding stuffs was revised by the legislature of 1925. The new law differs from the previous one chiefly in that: *(1) registration is compulsory; (2) a registration fee is required; (3) the maximum percentage of crude fiber must be stated in the analysis; and (4) ingredients of mixed feeds must be declared.*

The law provides that the Director of this Station and the Dairy and Food Commissioner, acting jointly, may make rules and regulations for carrying out the provisions of the law. Such rules and regulations, together with the text of the law, were issued in a special bulletin of this Station under date of June 30, 1925. Copies of this bulletin of information may still be obtained by request addressed to this Station.

The essential provisions of the new law, and other information pertaining to it, may be briefly restated here.

"Concentrated Commercial Feeding Stuffs" defined. Section 1 of the law defines the term "concentrated commerical feeding stuffs" in substantially the same way that it is defined in the old law; and with the same exemptions. Scratch grains are classed as concentrated feeds.

Labelling. Section 2 defines how concentrated commercial feeding stuffs shall be labelled. The label must declare (1) the number of net pounds of feed in the package; (2) the name, brand or trade mark under which the article is sold; (3) the name and address of the manufacturer or importer; (4) a statement of the minimum percentages of (a) crude protein, (b) crude fat, and (c) the maximum percentage of crude fiber, and (5) in case of feeds composed of two or more ingredients, the name of each ingredient contained therein.

Registration and registration fee. Section 3 requires the annual registration of concentrated commercial feeding stuffs and a registration fee of fifteen dollars ($15.00) for each brand. Registration is to be made with the Connecticut Agricultural Experiment Station on or before September 1, 1925, and annually thereafter.

Duties of Manufacturers. Manufacturers, jobbers or individ-

* Analyses are chiefly by Messrs. Nolan and Mathis; inspection and sampling by Mr. Churchill; and compilation largely by Miss Bacon.

uals shipping feeds into Connecticut will be expected to register their brands and pay the necessary fees thereon. Connecticut dealers should assure themselves that the brands they handle are *properly registered. In case the manufacturer or jobber outside* the State neglects or refuses to register, the dealer who handles such feeds will be held responsible for such registration and registration fees.

Dealers within the State who mix their own brands are responsible for the registration and proper labelling thereof.

Cottonseed Meal. Cottonseed meal registered as required by the fertilizer law is not exempt from registration also under the feed law if sold for feeding purposes.

Meaning of "Brand." It is held that a distinct brand name or a distinct guaranty constitutes a distinct brand.

Affixing Tags. The use of wire or any metal in affixing tags is prohibited by law.

Explanation of Terms Used in an Analysis of Feeding Stuff.

In registering feeding stuffs the law requires that the minimum percentages of crude protein and crude fat, and the maximum percentage of crude fiber, shall be given; that is, the registrant must guarantee that the feeds registered will contain *not less* than the stated percentages of crude protein and of crude fat and *not more* than the stated percentage of crude fiber.

The term *crude protein* denotes those nutrients which contain nitrogen, and is obtained by multiplying the percentage of total nitrogen in the feed by the factor 6.25.

The term *crude fat* denotes those substances which are soluble in ether and includes, besides fat, such non-fatty materials as chlorophyll and coloring matter.

The term *crude fiber* denotes the coarse, woody tissues characteristic of all forms of roughage and which are present in the outer coats of cereal and other fodder grains.

While the law requires only a statement of the three nutrients just defined, no objection is taken to more complete statements of composition, but such further statements, if given, must be correct. Thus, tags sometimes bear guaranties for nitrogen-free-extract and for carbohydrates.

The term *nitrogen-free-extract* denotes those nutrients of the starch and the sugar types. This group is never determined directly but is obtained by subtracting from 100 per cent the sum of the percentages of moisture, ash, crude protein, crude fiber and crude fat.

The term *carbohydrates* denotes the combined percentages of crude fiber and nitrogen-free-extract.

Registrations.

(For the period September 1st, 1925 to August 31st, 1926.)

One hundred sixty-one firms and individuals have registered 651 brands of feeding stuffs. As required by Statute these registrations are listed as follows:

American Agricultural Chemical Co., New Haven, Conn.
Capitol Meat and Bone Scrap
Protox Meat and Bone Scrap

American Linseed Co., 297 Fourth Ave., New York, N. Y.
Alinco Old Process Linseed Meal

American Maize-Products Co., 41 East 42d St., New York, N. Y.
Cream of Corn Gluten Feed

American Milling Co., Peoria, Ill.
Amco Old Process Linseed Meal and Old Process Screenings Oil Feed
Empire Dairy Ration
Kick-A-Poo Horse Feed
Sucrene Dairy Feed
Universal Dairy Ration

Arcady Farms Milling Co., Chicago, Ill.
Advanced Registry Dairy
Peerless Milk Ration

Archer-Daniels Midland Co., Minneapolis, Minn.
Pure Old Process Linseed Meal

Ashcraft-Wilkinson Co., Atlanta, Ga.
Helmet Brand Cottonseed Meal
Monarch Brand Cottonseed Meal
Paramount Brand Cottonseed Meal

Atlan Mfg. Co., 142 Logan Ave., Jersey City, N. J.
Diamond Pick Meat and Bone Scrap

Aunt Jemima Mills Branch, The Quaker Oats Co., St. Joseph, Mo.
Hominy Feed

E. W. Bailey & Co., Montpelier, Vt.
Capitol Dairy Ration
Favorite Dairy Ration
Pennant Scratch Feed
Pennant Stock Feed

Basic Feeds Co., Lockport, Ill.
No. 455 Scratch Grain

Bay State Milling Co., Winona, Minn.
Wingold Diamond G Pure Hard Wheat Low Grade Flour
Wingold Fancy Pure Hard Wheat Mixed Wheat Feed
Wingold Pure Hard Wheat Bran
Wingold Pure Hard Wheat Fancy White Flour Middlings
Wingold Rye Middlings and Rye Screenings
Wingold Standard Hard Wheat Middlings and Wheat Screenings

Beach Soap Co., Lawrence, Mass.
Beach's Star Brand Beef Scraps

Beacon Milling Co., Inc., Cayuga, N. Y.
Auburn Dairy Feed
Auburn Scratch Feed
Beacon Calf Meal
Beacon Dairy Ration
Beacon Egg Mash
Beacon Horse Feed
Beacon Laying Mash
Beacon Scratch Grains
Cayuga Scratch Feed

Ira W. Beers, Hamden, Conn.
Beers' Dairy Ration
Beers' Laying Mash
Beers' Scratch Feed

Blatchford Calf Meal Co., Waukegan, Ill.
Blatchford's Calf Meal
Blatchford's Chick Mash
Blatchford's "Fill-The-Basket" Egg Mash

Amos D. Bridges' Sons, Inc., Hazardville, Conn.
Success Dairy Ration

Buckeye Cotton Oil Co., Cincinnati, Ohio.
Buckeye 36% Protein Cottonseed Meal
Buckeye 41% Protein Cottonseed Meal

C. Buckingham & Co., Inc., Southport, Conn.
Buckingham's Dry Mash

C. W. Campbell Co., 27 West Broad St., Westerly, R. I.
Egg-O Dry Mash
Egg-O Scratch Feed
No-Botheration Dairy Ration
No-Botheration Stock Feed
Provender

Chapin & Co., 327 South LaSalle St., Chicago, Ill.
Ajax Dairy Ration
Unicorn Dairy Ration

Clinton Corn Syrup Refining Co., Clinton, Iowa.
Clinton Corn Gluten Feed

The Coles Co., Middletown, Conn.
Albert Angell Jr.'s Chick Starter
Albert Angell Jr.'s Coarse Chick Scratch
Albert Angell Jr.'s Egg Mash
Albert Angell Jr.'s Fine Chick Scratch
Albert Angell Jr.'s Growing Mash
Albert Angell Jr.'s Scratch Feed

Collis Products Co., Clinton, Iowa.
Collis Process Pure Dried Buttermilk

G. E. Conkey Co., Cleveland, Ohio.
Conkey's Buttermilk Grain and Bone Starting Feed
Conkey's Buttermilk Meat, Grain and Bone Growing Mash
Conkey's Buttermilk Meat, Grain and Bone Laying Mash
Conkey's Chick Grains
Conkey's Dairy Ration
Conkey's Fattening Mash with Buttermilk
Conkey's Growing Grains
Conkey's Pigeon Feed
Conkey's Scratch Grains
Gecco Chick Grains
Gecco Dairy Ration
Gecco Egg Mash
Gecco Fattening Mash without Buttermilk
Gecco Growing Grains
Gecco Scratch Grains
Red Seal Dairy Ration
Red Seal Scratch Feed

Conn. Fat Rendering and Fertilizer Corp., New Haven, Conn.
Meat Scrap 40%
Meat Scrap 50%

Copeland Flour Mills, Limited, Midland, Ontario, Canada.
Copeland's Dandy Bran
Copeland's Dandy Shorts

Corn Products Refining Co., 17 Battery Place, New York, N. Y.
Buffalo Corn Gluten Feed
Co-Pro-Co. Horse and Mule Feed
Diamond Corn Gluten Meal

C. A. Cowles, Plantsville, Conn.
C. A. Blue Seal Mash
C. A. Meato Mash
Cowles' Dairy Ration

Chas. M. Cox Co., Boston, Mass.
Lakewood's Wheat Bran (Lake of the Woods Milling Co., Ltd., Montreal, P. Q.)
Lakewood's Pure Standard Middlings (Lake of the Woods Milling Co., Ltd., Montreal, P. Q.)
Pioneer Pure Wheat Bran (Western Canada Flour Mills, Ltd., Toronto, Ont.)
Pioneer Shorts (Western Canada Flour Mills, Ltd., Toronto, Ont.)
Rex Wheat Middlings (Maple Leaf Milling Co., Ltd., Toronto, Ont.)
Wheat Bran (Maple Leaf Milling Co., Ltd., Toronto, Ont.)

Crosby Milling Co., Brattleboro, Vt.
Crosby's Balanced Ration
Crosby's Egg Mash
Crosby's Ready Ration
Crosby's Scratch Feed
Crosby's Stock Food
Crosby's 22% Dairy Feed

The Cutler Co., North Wilbraham, Mass.
King Dairy Ration
King Mash Feed
King Scratch
King Stock Feed

R. G. Davis & Sons, Inc., New Haven, Conn.
Basic Dairy Ration
Davis Horse Feed
Davis Mash Feed
Davis Scratch Feed
Davis Stock Feed
No. 1 Provender (corn and oats ground)

S. P. Davis, Little Rock, Ark.
Beauty Brand Cottonseed Meal
Good Luck Brand Cottonseed Meal
Steerboy Brand Cottonseed Meal

Decatur Milling Co., Decatur, Ill.
Homco Hominy Feed

Delaware Mills, Inc., 88 Front St., Deposit, N. Y.
Delaware Chick Starting Mash
Delaware Dairy Feed
Delaware Intermediate Chick Grains
Delaware Scratch Grains
Delaware Stock Feed

The Denver Alfalfa Milling & Products Co., Lamar, Col.
Alfalfa Meal

Devon Coal & Ice Co., Devon, Conn.
Devon Dairy Ration
Devon Laying Mash
Devon Sweet Stock Feed

Dewey Bros. Co., Blanchester, Ohio.
Ricormalt (Waterloo Distilling Corp., Waterloo, N. Y.)

Duluth Superior Milling Co., 620 Board of Trade Bldg., Duluth, Minn.
Boston Mixed Feed
Duluth Imperial Wheat Bran

Eagle Roller Mill Co., New Ulm, Minn.
Eagle Flour Midds with Screenings
Eagle Wheat Red Dog

Eastern States Farmers' Exchange, 33 Lyman St., Springfield, Mass.
Eastern States Buttermilk Egg Mash
Eastern States Egg Mash
Eastern States Fitting Ration
Eastern States FulPail
Eastern States Growing Mash
Eastern States Horse Feed
Eastern States Milkmore Dairy Ration
Eastern Scratch Grains

Elmore Milling Co., Oneonta, N. Y.

Elmore's Baby Chick Mash with Dried Buttermilk
Elmore's Calf Meal
Elmore's Egg Mash
Elmore's Growing Mash
Elmore's Hog Ration
Elmore's Horse Feed with Molasses
Elmore's Mekemgrow Little Pig Ration
Elmore's Milk Grains
Elmore's Poultry Mash with Buttermilk
Elmore's Red Dog Flour Middlings
Elmore's 20% Ready Ration
Elmore's Scratch Feed
Elmore's Snow Middlings
Elmore's Stock Feed
Emco Stock Feed

John W. Eshelman & Sons, Lancaster, Pa.

Eshelman's Lancaster 20 Dairy Feed
Eshelman's Lancaster 60 Horse Feed
Eshelman's Laying Mash
Eshelman's Red Rose 24 Dairy Feed
Eshelman's Red Rose 85 Horse Feed
Eshelman's Scratch Feed
Eshelman's Stock Feed
Eshelman's Sugared Stock Feed
Eshelman's Susquehanna Dairy Feed
Imperial Scratch Feed

Evans Milling Co., Indianapolis, Ind.

Emco Hominy Feed

Everett, Aughenbaugh & Co., Minneapolis, Minn.

E-A-CO Hard Wheat Mixed Feed with Wheat Screenings
E-A-CO Pure Wheat Bran
E-A-CO Pure Wheat Flour Middlings
E-A-CO Standard Middlings with Wheat Screenings

Fairchild Milling Co., 1635 Merwin St., Cleveland, Ohio.

Special Fine Wheat Middlings
Standard Middlings
Wheat Bran with Ground Wheat Screenings

The Fairmont Creamery Co., Omaha, Neb.

Fairmont's Better Condensed Buttermilk
Fairmont's Better Pure Flake Buttermilk

Federal Mill & Elevator Co., Inc., Lockport, N. Y.

Dairy Maid Winter Wheat Middlings
Dairy Maid Winter Wheat Mixed Feeds
Lucky Hard Wheat Bran
Sphinx Fancy Hard Wheat Middlings

Flory Milling Co., Inc., Bangor, Pa.

- Ata-Boy Horse Feed
- Blue Mountain Horse Feed
- *Buzz Horse Feed*
- Flory's Special Stock Feed (Samp Mortar Milling Co., Fairfield, Conn.)
- Flory's Superior Egg Mash
- Flory's Superior Pure Wheat Middlings
- Flory's Superior Scratch Grains
- Globe Cow Feed
- *Golden Egg Laying Mash*
- Golden Egg Scratch Feed
- National Cow Feed
- Sunray Scratch Feed

A. W. Forbes, East Haven, Conn.

- Dairy Ration
- Laying Mash
- R-OWN Scratch Feed

The L. T. Frisbie Co., New Haven, Conn.

- Frisbie's Bone Meal 20-25% Protein (For cattle and poultry)
- *Frisbie's Bone and Meat Meal 35-45% Protein*
- Frisbie's Cracked Bone
- Frisbie's Poultry Feed 45-55% Protein
- Frisbie's Poultry Feed 55-65% Protein

The Galt Flour Mills, Limited, Galt, Ontario, Canada.

- Rainbow Bran
- Rainbow Shorts

Grain Belt Mills Co., St. Joseph, Mo.

- *Hunter Horse and Mule Feed*

D. H. Grandin Milling Co., Jamestown, N. Y.

- *Grandin's Baby Chick Feed*
- Grandin's Baby Chick Starter with Buttermilk
- Grandin's 24% Balanced Dairy Ration
- Grandin's Growing Feed
- Grandin's Intermediate Chick Feed
- Grandin's Laying Mash with Buttermilk
- Grandin's Milk Maker
- *Grandin's Screened Scratch Feed*
- Grandin's Stock Food
- Grandin's 12 Twin Six 12 Dairy Feed

Hales & Hunter Co., 320 South LaSalle St., Chicago, Ill.

- Red Comb Egg Mash with Dried Buttermilk
- Red Comb Growing Mash

Wm. Hamilton & Son, Inc., Caledonia, N. Y.

- Wheat Bran
- Wheat Middlings

Dwight Hamlin Co., Pittsburgh, Pa.

The Hecker-H-O Co., Inc., Genesee Bldg., Buffalo, N. Y.
Algrane Horse Feed
Algrane Milk Feed
Algrane New England Stock Feed
Algrane Steam-Cooked Chick Feed

Hecker-Jones-Jewell Milling Co., 40 Corlears St., Buffalo, N. Y.
Choice Wheat Bran
Choice Wheat Bran with Ground Screenings
Extra Heavy Wheat Mixed Feed with Ground Screenings
H Wheat Middlings
Red Dog Flour
Wheat Flour Middlings
Wheat Red Dog Flour
Wheat Standard Middlings with Ground Screenings

Hirst & Begley Linseed Works, 2013 Mendel St., Chicago, Ill.
Hirst & Begley Linseed Works Old Process Linseed Meal

The J. C. Hubinger Bros. Co., Keokuk, Iowa.
Keokuk Corn Gluten Feed

L. W. Hudson, Windsor, Conn.
"Hudson's" 50/50 Scratch
"Hudson's" Laying Mash
"Hudson's" Cow Feed

Humphreys-Godwin Co., Memphis, Tenn.
Bull Brand Cottonseed Meal
Danish Brand Cottonseed Feed
Dixie Brand Cottonseed Meal

Imperial Grain & Milling Co., Toledo, Ohio.
Imperial Steam Cooked Feed

Z. C. Ingersoll, Stratford, Conn.
Ingersoll's Special Egg Mash

International Milling Co., Minneapolis, Minn.
Black Hawk Pure Wheat Bran (Minneapolis Mills, U. S. A.)
Black Hawk Pure Wheat Bran (Robin Hood Mills, Canada)
Black Hawk Pure Wheat Shorts (Robin Hood Mills, Canada)
Black Hawk Wheat Standard Middlings (Minneapolis Mills, U. S. A.)

Henry James & Son, Inc., Worcester, Mass.
H. J. Selected Meat Scraps

Kellogg & Miller, Amsterdam, N. Y.
Old Process Linseed Oil Meal

Kellogg Sales Co., Battle Creek, Mich.
K. B. C. White Hominy Feed

Spencer Kellogg & Sons, Inc., Buffalo, N. Y.
"Kellogg's" Pure Old Process Linseed Meal

H. H. King Flour Mills Co., 1010 Chamber of Commerce, Minneapolis, Minn.
"Gold Mine" Feed

Chas. A. Krause Milling Co., Milwaukee, Wis.
Badger Stock Feed

The Larrowe Milling Co., Box 68 North End Station, Detroit, Mich.
Dried Beet Pulp
Larrowe Brand Choice Cottonseed Meal
Larro Chick Grains
Larro Chick Starter
Larro Egg Mash
Larro Growing Grains
Larro Growing Mash
Larro Scratch Grains
Larro—The Ready Ration for Dairy Cows

Francis H. Leggett Co., 37 Jefferson St., Stamford, Conn.
Nabob Dairy Feed
Nabob Horse Feed
Nabob Scratch Feed
Nabob Stock Feed
Premier Dairy Feed
Premier Growing Mash
Premier Laying Mash
Premier Scratch Feed

C. W. Lines Co., Cor. Chestnut and Bigelow Sts., New Britain, Conn.
Homestead Dry Mash
Homestead Scratch Feed
Uniform Brand Dairy Ration
Uniform Brand Fancy Scratch Feed

Litchfield County Coöperative Association, Torrington, Conn.
Common Sense Dairy Ration

E. Manchester & Sons, Winsted, Conn.
Red Star Buttermilk Mash
Red Star Dairy Feed
Red Star Egg Mash
Red Star Special Dairy Feed
Red Star Wheat Mixed

The Mann Bros. Co., Buffalo, N. Y.
Pure Old Process Linseed Meal, 34% Protein

Mapl-Flake Mills, Inc., Chicago, Ill.
Armour's Cak-Cak Growing Feed
Armour's Cak-Cak Laying Mash
Armour's 24% Dairy Feed
Armour's Horse Feed
Armour's Stock Feed
Bufceco Hominy Feed
Iroquois Chop Feed
Iroquois 20% Dairy Ration

Iroquois Laying Mash
Iroquois Poultry Mash
Iroquois Scratching Grains
Iroquois Stock Feed
Iroquois Sweet Horse Feed
Oat Feed

Maritime Milling Co., Inc., Buffalo, N. Y.
Bull Brand Chick Feed
Bull Brand Chick Starter (with Dried Buttermilk)
Bull Brand Dairy Ration
Bull Brand Heavy Mixed Feed
Bull Brand Laying Mash (with Dried Buttermilk)
Bull Brand Scratch Feed
Bull Brand Stock Feed
Hi-Test Dairy Feed
Red Dog Wheat Flour
Red E Lay Laying Mash
Red E Mixt Scratch Feed

A. G. Markham & Co., Springfield, Mass.
Cooked Meat and Bone Scrap

The Geo. E. Marsh Co., Lynn, Mass.
Marsh's Pure Ground Scraps for Poultry

G. J. Martenis Grain Co., L-3 Produce Exchange, New York, N. Y.
Alco Dried Distilled Grains

Meech & Stoddard, Inc., Middletown, Conn.
Red Wing Dairy Ration (without Brewers' Grains)
Red Wing Mixed Feed
Red Wing Molasses Horse Feed
Red Wing Special Buttermilk Growing Feed
Red Wing Special Dairy Ration (without Brewers' Grains)
Red Wing Special Dry Mash
Red Wing Special Buttermilk Laying Mash
Red Wing Special Buttermilk Chick Starter
Red Wing Stock Feed
Red Wing Special Chick Feed
Red Wing Special Intermediate Chick Feed
Red Wing Scratch Feed
Red Wing Special Stock

Memphis Cottonseed Products Co., Memphis, Tenn.
Durham Fortythree Cottonseed Meal
Durham Fortyone Cottonseed Meal
Durham Thirtysix Cottonseed Meal

Middlesex Refining Co., Middletown, Conn.
Middlesex Beef Scrap

Miner-Hillard Co., Wilkes-Barre, Pa.
No. 1 Scratch Feed
Rye Middlings
Steam Cooked Hominy Feeds

Geo. Q. Moon & Co., Inc., Binghamton, N. Y.
Moon's Fresh Ground Mixed Feed
Old Times Horse Feed
Special A Scratch Feed

Moran-Patton Co., 230-236 Cedar St., New Haven, Conn.
C. B. Mash

Fred C. Morse, Guilford, Conn.
Old Mill Buttermilk Laying Mash
Old Mill Dairy Ration
Old Mill Mash Feed
Old Mill Provender
Old Mill Scratch Feed

Mt. Vernon Milling Co., Mt. Vernon, Ind.
Poco Hominy Feed

Mystic Milling & Feed Co., Rochester, N. Y.
Genesee Scratching Grains

National Milling Co., Toledo, Ohio.
Osota Feed

R. N. Neal & Co., Inc., Memphis, Tenn.
"Triangle" Brand Prime 36% Protein Cottonseed Meal
"Triangle" Brand 43% Protein Cottonseed Meal

N. E. By-Products Corp., 20 West St., Lawrence, Mass.
Blue Seal Meat Scraps
White Seal Meat Scraps

Newsome Feed & Grain Co., Carson Station, Pittsburgh, Pa.
Palmo Midds

Niagara Falls Milling Co., Niagara Falls, N. Y.
Choice Wheat Middlings

Northwestern Consolidated Milling Co., Minneapolis, Minn.
Planet Feed
Pure Wheat Bran
Wheat Flour Midds
Wheat Mixed Feed
Wheat Standard Midds
XXX Comet

Norton Tallow Co., Somerville, Mass.
Norton's High Grade Meat and Bone Poultry Feed
Norton's High Grade Bone Meal for Poultry

Nowak Milling Corporation, Hammond, Ind.
Domino Alfalfa Horse Feed
Domino Baby Chick Starter with Buttermilk
Domino Butterine Dairy Feed
Domino Chick Feed

Domino Crate Fattener with Buttermilk
Domino Developing Feed
Domino 24½% Dry Dairy Feed
Domino Growing Mash with Buttermilk
Domino Hog Feed
Domino Laying Mash with Buttermilk
Domino Pep O Lene Horse Feed
Domino Pigeon Feed
Domino Scratch Feed
Domino Union Dairy Feed
Domino Vim O Lene Horse Feed
Export Scratch Feed
Fidelity Dairy Feed
Fidelity Horse Feed
Fidelity Scratch Feed
Fidelity Stock Feed
Hammond Dairy Feed
Marathon Chick Feed
Marathon Dairy Feed
Marathon Horse Feed
Marathon Laying Mash with Buttermilk
Marathon Scratch Feed

The Ogilvie Flour Mills Co., Ltd., Montreal, Canada.
Ogilvie's Pure Wheat Bran
Ogilvie's Pure Wheat Shorts

Ontario Milling Co., Inc., Oswego, N. Y.
Uncle John's 24% Cream Pot Ration

Estate of S. V. Osborn, Branford, Conn.
Osborn Mash
Osborn Provender
Osborn Scratch

The Park & Pollard Co., Inc., Buffalo, N. Y.
Arlington Horse Feed
Baby Buster Chick Feed
Belmont Horse Feed
Bet-R-Milk Ration
Bidwell Dry Mash (Black Rock Milling Co.)
Bidwell Scratch Feed (Black Rock Milling Co.)
Bison Stock Feed Sweetened
Bonnie Booster
Chelsea Horse Feed
Corn Feed Meal
Corn and Oats ½ & ½
Economy Feed
GoTuIt Hog Ration
Growing Feed
Herdhelth Ration
Intermediate Chick Feed
Lay or Bust Dry Mash
Leghorn Special Dry Mash
Milk Maid 24% Dairy Ration
Overall 24% Dairy Ration
Over the Top Scratch Feed
Pigeon Feed

Pretty Special Mixed Feed
Red Ribbon Chick Feed
Red Ribbon Scratch Feed
Stevens "44" Dairy Ration
Stevens "44" Sweetened Dairy Ration
Stevens Milkade Calf Meal
The Park & Pollard Dairy Growing Ration
The Park & Pollard 16% Dairy Ration
The Park & Pollard 20% Dairy Ration
The Park & Pollard Co. Stock Feed
Universal Ration
Wheat Flour Middlings

The Patent Cereal Co., Geneva, N. Y.
Hominy Feed

Penick & Ford, Ltd., Inc., Cedar Rapids, Iowa.
Douglas Corn Gluten Feed
Douglas Corn Gluten Meal

M. C. Peters Mill Co., Omaha, Neb.
Peter's Alfalfa Flour
Peter's Arab Horse Feed

Peterson-Hendee Co., Derby, Conn.
P-H Mash
P-H Scratch Feed

Pillsbury Flour Mills Co., Minneapolis, Minn.
Dairy Ration
Durum Wheat Bran and Screenings
Fancy Mixed Feed and Screenings
Hard Wheat A Middlings and Screenings
Hard Wheat Bran and Screenings
Hard Wheat Standard B Middlings and Screenings
Palisade Chick Feed
Palisade Scratch Feed No Grit
Pillsbury's Chick Grains No Grit
Pillsbury's Egg Mash
Pillsbury's Growing Grains
Pillsbury's Growing Mash with Buttermilk
Pillsbury's Scratch Grains
Pillsbury's Starting Food with Buttermilk
Rye Middlings and Screenings
Wheat Bran and Screenings
Wheat Gray Shorts
XX Daisy

Frank S. Platt Co., New Haven, Conn.
Platco Perfection Grain Mixture
Platt's Pigeon Mixture
Platco Laying Mash

Postum Cereal Co., Inc., Battle Creek, Mich.
Burt's Dairy Feed
Burt's Cereal Feed
Burt's Hominy Feed
Burt's Stock Feed

Pratt Food Co., Philadelphia, Pa.

Pratt's Baby Chick Food with Buttermilk
Pratt's Supreme Growing Mash with Buttermilk
Pratt's Supreme Pigeon Feed with Corn
Pratt's Supreme Stock Feed
Pratt's Victory Laying Mash
Pratt's Victory Large Scratch Feed

H. C. Puffer Co., 194 Lyman St., Springfield, Mass.

Egg-Em-On Growing Feed
Egg-Em-On Laying Mash
Egg-Em-On Scratch Grains
Producer Dairy Feed

Quaker Oats Co. (Aunt Jemima Mills Branch), Chicago, Ill.

Bell Cow Bran with Ground Screenings
Bell Cow Shorts with Ground Screenings
Big Egg Scratch Grains No Grit
Big "Q" Dairy Ration
Boss Dairy Ration
Buckeye Feed
Fine Ground Oat Feed
Ful-O-Pep Chick Starter
Ful-O-Pep Coarse Chick Feed
Ful-O-Pep Egg Mash
Ful-O-Pep Fine Chick Feed
Ful-O-Pep Growing Mash
Ful-O-Pep Scratch Grains
Green Cross Horse Feed
Quaker Dairy Feed
Richford White Diamond Stock Feed
Schumacher Calf Meal
Schumacher Feed
Schumacher Little Chick Feed
Schumacher Scratch Grains, No Grit
Sterling Stock Feed with Molasses
Sugared Schumacher Feed
Vim Feed
White Hominy Feed
Yellow Hominy Feed

Ralston Purina Co., St. Louis, Mo.

Protena Dairy Feed
Purina Baby Chick Chow Feed
Purina Calf Chow Feed
Purina Chicken Chowder Feed
Purina Chicken Fat Chow Feed
Purina Chicken Fatena Feed
Purina Chick Growena Feed
Purina Chick Startena Feed
Purina Cow Chow Feed
Purina Hen Chow Feed
Purina Intermediate Hen Chow Feed
Purina Legume Chow Feed
Purina O Molene Feed
Purina Pig Chow Feed
Purina Pigeon Chow Feed
Purina Steer Fatena Feed
Winner Scratch Feed

E. Rauh & Sons Animal Feed Co., Indianapolis, Ind.
Rauh's Meato

John Reardon & Sons Co., Cambridge, Mass.
Reardon's 45% Meat and Bone Scrap
Reardon's 55% Meat Scrap

The Red Wing Milling Co., Red Wing, Minn.
Red Wing Special Wheat Bran with Ground Screenings

Rockville Grain & Coal Co., Rockville, Conn.
Diamond Scratch Feed

Rosenbaum Bros., 208 South LaSalle St., Chicago, Ill.
Advance Dairy Feed
Advance Egg Mash
Advance Horse Feed
Advance Scratch, No Grit
Four O'Clock Scratch Grains
Horse Sense Grain Feed
Rosebro Horse Feed
"77" Chick Scratch, No Grit
"77" Dairy Feed
"77" Horse Feed
"77" Scratch Feed, No Grit
"77" Stock Feed
Special Rosebro Horse Feed
Sugared Vitality
Vitality Chick Starter
Vitality Coarse Chick Screenings
Vitality Dairy Feed
Vitality Egg Mash with Buttermilk
Vitality Egg Mash without Buttermilk
Vitality Fattening Feed
Vitality Fine Chick Screenings
Vitality Growing Mash
Vitality Horse Feed
Vitality Milk Ration
Vitality Pigeon Feed, No Corn, No Grit
Vitality Scratch, No Grit
Vitality Stock Feed
Will Pay Dairy Ration

Russell Miller Milling Co., Minneapolis, Minn.
Alta Hard Wheat Middlings
Hard Wheat Occident Bran
Hard Wheat Occident Mixed Feed

Russia Cement Co., Gloucester, Mass.
Chic-Chuk "The Ideal Concentrated Poultry Food"

The Paty Schwartz Co., New London, Conn.
Homespun Dairy Ration
Homespun Laying Mash
Homespun Scratch Grains
Homespun Stock Feed

Seymour Grain & Coal Co., Seymour, Conn.
"See-More Egg" Buttermilk Mash
"See-More Milk" Dairy Ration
"See-More Egg" Scratch Feed

The Sheets Elevator Co., Cleveland, Ohio.
Diamond Horse Feed
Haskell's Stock Feed
S. B. Alfalfa Horse Feed
S. B. Horse and Mule Feed

Sheffield Elevator Co., Minneapolis, Minn.
Sherwin-Williams Old Process Meal

Shelton Feed Co., Shelton, Conn.
Nelson Mixed Chicken Feed
Nelson Laying Mash

Winchell Smith, Inc., Farmington, Conn.
"Mill Streams" Boomerang Dairy Feed
"Mill Streams" Fortune Hunter Scratch Grains
"Mill Stream" "Lightnin" Laying Mash
"Mill Streams" Twenty Percent Dairy Ration

Springfield Rendering Co., Springfield, Mass.
Springfield Bone Meal
Springfield Ground Meat Scraps

A. E. Staley Mfg. Co., Decatur, Ill.
Staley's Corn Gluten Feed

St. Albans Grain Co., St. Albans, Vt.
Brewers' Dried Grains
Charlestock Feed
Paragon Dairy Feed for Dairy Cows
Paragon Hominy Feed
Paragon Scratch Feed
Wirthmore Balanced Ration for Dairy Cows
Wirthmore Buttermilk Mash Feed with Fish and Meat Scraps
Wirthmore 20% Dairy Feed
Wirthmore Flour Middlings
Wirthmore Gritless Chick Feed
Wirthmore Growing Feed with Dried Buttermilk and Beef Scraps
Wirthmore Intermediate Chick Feed
Wirthmore Scratch Feed
Wirthmore Stock Feed
Wirthmore 16% Summer Ration Containing Minerals
Wirthmore Wheat Feed

John T. Stanley Co., Inc., 642 West 30th St., New York, N. Y.
Stanley's 45% to 50% Protein Meat Scrap

St. Lawrence Flour Mills Co., Ltd., Montreal, Canada.
Bran

David Stott Flour Mills, Detroit, Mich.
Hominy Feed

Syracuse Milling Co., Syracuse, Onondaga County, N. Y.

Onondaga Dairy Feed
Onondaga Scratch Grains
Symco Scratch Grains
Syragold Chick Feed
Syragold Chick Starter
Syragold Dairy Feed
Syragold Dry Mash
Syragold Egg Mash
Syragold Growing Mash
Syragold Milk Ration
Syragold Scratch Grains
Syragold Stock Feed

Thornton & Chester Milling Co., 110 Pearl St., Buffalo, N. Y.

T & C Wheat Bran
T & C Wheat Midds
T & C Wheat Mixed Feed
T & C Wheat Standard Midds

Tioga Mill & Elevator Co., Waverly, N. Y.

Derby Corn and Oat Feed
Derby Horse Feed
Derby Meal
Derby Scratch Feed
Egatine
Or-Co Feed
Red Brand Tioga Dairy Feed
Tioga Laying Feed

Ubiko Milling Co., Cincinnati, Ohio.

Dried Beet Pulp
"Union Grains" Ubiko Biles Ready Dairy Ration

United Flour & Feed Co., 26 Gansevoort St., Albany, N. Y.

Cowles' Special Laying Mash
Cowles' Special Scratch Feed
Ground-Corn-Oats ½ & ½
Rex Dairy Feed
Rex Scratch Feed
United Dairy Ration
United Laying Mash (Storrs Formula)
United Laying Mash (with Buttermilk)
United Scratch Feed
United Wheat Flour Middlings
Waldorf Milk Grains

Van Iderstine Co., Railroad and Greenpoint Aves., Long Island City, N. Y.

VICO High Protein Meat Scrap for Poultry

Van Vechten Milling Co., Inc., Rochester, N. Y.

Irving Mills Rye Feed

Victor Flour Mills, Pittsford, N. Y.

Victor Spring Wheat Bran with Ground Screenings
Victor Spring Wheat Middlings with Ground Screenings

Washburn-Crosby Co., Minneapolis, Minn.

Eventually Gold Medal Chick Feed—No Grit
Eventually Gold Medal Chick Mash (with Dried Buttermilk)
Eventually Gold Medal Developing Feed—No Grit
Eventually Gold Medal Growing Mash (with Dried Buttermilk)
Eventually Gold Medal Hard Wheat Bran and Wheat Screenings
Eventually Gold Medal Hard Wheat Flour Middlings and Wheat Screenings
Eventually Gold Medal Hard Wheat Mixed Feed and Wheat Screenings
Eventually Gold Medal Hard Wheat Standard Middlings and Wheat Screenings
Eventually Gold Medal Pure Hard Wheat Adrian Red Dog
Eventually Gold Medal Scratch Feed—No Grit
Eventually Gold Medal Stock Feed
Eventually Gold Medal Vitamin Dairy Ration (containing wheat germ embryo)
Eventually Gold Medal Vitamin Dairy Ration (24% Protein)
Eventually Gold Medal Vitamin Egg Mash (containing wheat germ embryo) 20-8.5-5.0
Eventually Gold Medal Vitamin Egg Mash (containing wheat germ embryo) 20-8.5-5.5
Gold Medal Corn and Oat Feed No. 2
Gold Medal Hominy Feed (Guaranteed Pure)
North Store Scratch Feed—No Grit
Sonny South Hominy Feed (Louisville Milling Co., Louisville, Ky.)

Wilson & Co., Chicago, Ill.

Red "W" Meat Scraps 50%
Red "W" Meat Scraps 55%

Worcester Rendering Co., Auburn, Mass.

P. W. Bone Meal
P. W. Meat Scrap
P. W. Special Meat Scrap

Yantic Grain & Products Co., Norwich, Conn.

Big (Y) Dairy Ration
Big (Y) Flour Middlings
Big (Y) Growing Feed
Big (Y) Laying Mash
Big (Y) Mixed Feed
Echo Dairy Feed
Perfection Dairy Feed
Uncas Dairy Feed
Uncas Scratch Feed
Uncas Stock Feed

Inspection for 1925.

During the year analyses of 755 samples of feeding stuffs and other forms of fodder materials have been made. Of these, 488 represent official samples drawn by the station inspector, and 52 were unofficial samples submitted by individuals. The remainder, 215 in number, were examined for the Storrs station in connection with field and other experiments, and are not discussed in this report.

Our inspector has visited 87 cities and towns of the State and drawn 543 samples of feeding stuffs up to the time of closing this report, March 1st, 1926. This number includes all of the brands which could be found on sale.

Inspection of feeding stuffs is done largely in the fall months so that the analytical work connected therewith may be finished before the beginning of the fertilizer inspection. But many feeds, particularly poultry feeds, do not appear in the market until spring. Such must, therefore, be sampled and examined as they are found and will be included in our report for next year.

As soon as samples are examined the results are reported to the manufacturers or jobbers and to the dealers, or others from whose stocks the samples were drawn. In cases of deficiencies check samples have been taken from other sources if possible.

Official samples analyzed for inspection purposes may be classified as follows:

Cottonseed products	12
Linseed products	7
Wheat products	75
Rye products	2
Maize products	25
Brewers' and Distillers' products	2
Dried beet pulp	1
Proprietary Mixed Feeds:	
Horse feeds	35
Dairy feeds	93
Stock feeds	34
Calf feeds, etc.	4
Poultry feeds	164
Beef scrap, etc.	34
Total	488

Analyses of official samples are given in Table I. Results for protein and crude fiber which fail to meet guaranties by more than 0.75 per cent in each case, and for fat which are deficient by more than 0.25 per cent, are given in bold face type.

The inspection can best be summarized in the following tabulated statement.

Kind of Feed	Samples examined	Samples deficient	No. deficient in protein	No. excessive in fiber	No. deficient in fat	Total deficiencies	Percentages substantially conforming to, or exceeding, guaranties
Cottonseed Meal	11	2	2	0	0	2	..
Cottonseed Feed	1	0	0	0	0	0	..
Linseed Meal	7	0	0	0	0	0	..
Wheat Bran	21	0	0	0	0	0	..
Wheat Middlings	28	1	1	0	0	1	..
Wheat Red Dog	5	2	0	0	2	2	..
Wheat Feed	21	4	0	1	1	2	..
Rye Products	2	0	0	0	0	0	..
Corn Gluten Feed	6	0	0	0	0	0	..
Corn Gluten Meal	2	0	0	0	0	0	..
Corn Feed Meal	2	0	0	0	0	0	..
Hominy Feed	15	4	0	0	4	4	..
Brewers' and Distillers' Grains	2	2	2	0	1	3	..
Dried Beet Pulp	1	0	0	0	0	0	..
Total	124	13	5	1	8	14	90
Proprietary feeds, including beef scrap:							
Horse Feed	35	11	3	6	7	16	..
Dairy Feed	93	16	2	3	11	16	..
Stock Feed	34	12	2	7	4	13	..
Calf Feed, etc.	4	0	0	0	0	0	..
Poultry Feed	164	20	7	2	11	20	
Beef Scrap, etc.	34	10	9	..	1	10	..
Total	364	69	23	18	34	75	80
Total	488	82	28	19	42	89	83

From this summary it is evident that of non-proprietary feeds only about 10 per cent failed to conform to their guaranties by any considerable amounts; in other words 90 per cent substantially met or exceeded their guaranties.

In the case of proprietary mixed feeds, as might be expected, the proportion of deficiencies is greater; here only 80 per cent substantially met or exceeded guaranties.

For the total number of samples about 17 per cent fell considerably short of guaranties; 83 per cent substantially conformed thereto.

A total of 1443 guaranties are represented by the 488 samples analyzed, of which 1351, or 94 per cent, have been substantially met or exceeded.

Only three instances of tags being attached by means of wire were found. This practice is illegal in this State.

In one instance a minimum fiber guaranty was given whereas the law requires that the maximum shall be stated. This manufacturer was notified to revise his tags to conform to the legal requirements.

In a previous report[1] it was shown that for the five-year period 1920-24 a total of 864 official samples of feeding stuffs had been examined, and of these 83 had shown considerable deficiencies in one or more of the guaranteed ingredients. In other words about 90 per cent practically conformed to the guaranteed analyses.

The data for the past year shows a corresponding percentage which is somewhat lower, viz., 83 per cent. There are two reasons for this. During the last year samples have been judged somewhat more stringently as to deficiencies; but chiefly, the proportion of proprietary feeds, in which the number of deficiencies is greatest, has comprised about ¾ of the total samples whereas in the five-year period this group comprised only about ½ of the samples examined.

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[1] Conn. Exp. Station Bull. 268, 1924.

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1925.

Station No.	Manufacturer and Brand	Retail Dealer	Pounds per Hundred								
			Water	Ash	Protein (N x 6.25)		Fiber		Nitrogen-free extract (starch, gum, etc.)	Fat	
					Found	Guaranteed, not less than	Found	Guaranteed, not more than		Found	Guaranteed, not less than
	OIL SEED PRODUCTS.										
	Cottonseed Meal.										
3134	*Helmet.* Ashcraft-Wilkinson Co., Atlanta, Ga.	*New Milford:* Geo. T. Soule	6.40	5.20	41.50	41.00	10.29	10.00	29.95	6.66	6.00
3133	*Monarch.* Ashcraft-Wilkinson Co., Atlanta, Ga.	*New Milford:* Geo. T. Soule	6.74	6.08	44.56	43.00	7.15	10.00	26.69	8.78	6.00
3132	*Paramount.* Ashcraft-Wilkinson Co., Atlanta, Ga.	*Canaan:* Ives & Pierce	7.55	6.11	36.75	36.00	12.70	14.00	30.44	6.45	5.50
3082	*Buckeye.* Buckeye Cotton Oil Co., Cincinnati, Ohio	*Danielson:* Dayville Grain Co.	5.58	5.07	37.44	36.00	13.18	14.00	31.26	7.47	5.00
3527	*Beauty.* S. P. Davis, Little Rock, Ark.	*Wallingford:* A. E. Hall	5.23	5.26	39.06	36.00	12.14	14.00	32.31	6.00	6.00
3581[1]	*Steerboy.* S. P. Davis, Little Rock, Ark.	*Middletown:* Meech & Stoddard, Inc.	7.15	6.00	41.38	43.00	9.58	10.00	28.53	7.36	6.00
3022	*Dixie.* Humphreys-Godwin Co., Memphis, Tenn.	*Bethel:* Morrison & Dunham	6.54	5.53	40.19	41.12	10.74	10.00	29.15	7.85	5.00
3579[1]	"*Lovit.*" L. B. Lovitt & Co., Memphis, Tenn.	*Middletown:* Meech & Stoddard, Inc.	9.53	5.10	36.94	36.00	13.83	14.00	28.69	5.91	5.00
3519	*Durham.* Memphis Cottonseed Products Co.	*Waterbury:* Spencer Grain Co.	6.43	5.13	39.81	36.00	10.70	14.00	29.38	8.55	5.00
3089	"*Triangle.*" R. N. Neal & Co., Memphis, Tenn.	*New Haven:* R. G. Davis & Sons	5.89	5.00	36.81	36.00	13.68	14.00	32.43	6.19	5.00

[1] Wire tags, illegal. Registered after March 1st, 1926.

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1925—*Continued.*

Station No.	Manufacturer and Brand	Retail Dealer	Pounds per Hundred: Water	Ash	Protein N x 6.25: Found	Protein: Guaranteed, not less than	Fiber: Found	Fiber: Guaranteed, not more than	Nitrogen-free extract (starch, gum, etc.)	Fat: Found	Fat: Guaranteed, not less than
	OIL SEED PRODUCTS—*Continued.*										
	Cottonseed Meal—Continued.										
3165	*"Triangle"* 43%. R. N. Neal & Co., Memphis, Tenn.	*Plantsville:* C. A. Cowles	6.10	6.99	45.63	43.00	7.70	10.00	26.49	7.09	6.00
	Cottonseed Feed.										
2937	*Danish.* Humphreys-Godwin Co., Memphis, Tenn.	*Hamden:* Ira W. Beers	5.55	6.22	40.25	36.00	10.60	15.00	31.10	6.28	5.00
	Linseed Meal, Old Process.										
3104	*Amco.* American Milling Co., Peoria, Ill.	*New Haven:* R. G. Davis & Sons	8.14	5.12	31.25	30.00	8.63	10.00	40.00	6.86	5.00
3518	*Pure.* Archer Daniels Midland Co., Minneapolis, Minn.	*Seymour:* Seymour Grain & Coal Co.	8.33	4.81	35.31	34.00	7.40	9.00	38.32	5.83	5.00
3144	Hirst & Begley, Chicago, Ill	Mfr's Sample	6.62	4.98	38.06	34.00	7.13	9.00	36.23	6.98	6.00
2261	*Pure.* Mann Bros. Company, Buffalo, N. Y.	*Norfolk:* Aug. P. Curtis	10.22	4.50	34.63	34.00	7.85	10.00	35.24	7.56	6.00
2248	*Kellogg's.* Spencer Kellogg, Buffalo, N. Y.	*Plantsville:* C. A. Cowles	8.50	4.87	36.25	34.00	7.60	10.00	36.93	5.85	5.00
3073	Kellogg & Miller, Amsterdam, N. Y.	*Derby:* Peterson-Hendee Co.	8.58	4.75	35.50	34.00	7.31	9.00	37.76	6.10	4.00
3535	Sherwin-Williams Co., Winnepeg, Canada	*Newtown:* R. H. Holcomb & Co.	6.28	5.23	36.69	35.00	7.88	7.50	35.54	8.38	5.50

[illegible]

Station No.	Manufacturer and Brand	Retail Dealer	Water	Ash	Protein N x 6.25: Found	Protein N x 6.25: Guaranteed, not less than	Fiber: Found	Fiber: Guaranteed, not more than	Nitrogen-free extract (starch, gum, etc.)	Fat: Found	Fat: Guaranteed, not less than
	Wheat Products.										
	Wheat Bran.										
2824	*Dandy.* Copeland Flour Mills, Midland, Canada	*Merrow:* I. F. Wilcox	10.00	5.30	15.00	15.00	10.38	11.50	53.64	5.68	3.50
2957	*Duluth Imperial.* Duluth Superior Milling Co., Duluth, Minn.	*Putnam:* Dayville Grain & Coal Co.	9.33	5.05	14.88	14.00	8.45	13.00	56.56	5.73	3.75
2939	*Rainbow.* The Galt Flour Mills, Galt, Canada	*New Hartford:* Geo. W. Case	9.18	5.70	16.88	15.00	10.08	11.50	51.81	6.35	3.50
2290	Wm. Hamilton & Son, Honeoye, Falls, N. Y.	*Derby:* Peterson-Hendee Co.	10.33	5.78	14.44	13.25	8.41	11.60	57.00	4.04	2.90
2223	*Choice.* Hecker - Jones - Jewell *Milling Co., New York City*	*Ansonia:* Ansonia Flour & Feed Co.	10.25	5.88	15.00	13.00	9.58	14.00	53.81	5.48	3.50
2930[2]	*Choice.* Hecker - Jones - Jewell Milling Co., New York City	*New Haven:* R. G. Davis & Sons	10.55	6.11	14.88	13.50	8.94	14.00	53.99	5.53	3.50
2370	*Lakewood.* Lake of the Woods Milling Co., Montreal, Canada	*Hazardville:* Amos D. Bridges' Sons	9.48	5.37	14.75	15.00	10.08	11.50	54.65	5.67	3.50
2293	Maple Leaf Milling Co., Toronto, Canada	*Hamden:* Ira W. Beers	9.38	5.41	15.81	15.00	9.48	11.50	54.44	5.48	3.50
2800	Maple Leaf Milling Co., Toronto, Canada	*Lakeville:* E. W. Spurr Co.	9.68	5.20	15.56	15.00	9.39	11.50	54.91	5.26	3.50
2879[3]	*Niagara Choice.* Niagara Falls Milling Co., Niagara Falls, N. Y.	*Meriden:* H. Grulich	9.55	5.50	15.13	15.00	9.23	11.00	54.95	5.64	3.50

[2] With screenings. [3] Registered after March 1st, 1926.

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1925—*Continued.*

Station No.	Manufacturer and Brand	Retail Dealer	Water	Ash	Protein N x 6.25 Found	Protein Guaranteed, not less than	Fiber Found	Fiber Guaranteed, not more than	Nitrogen-free extract (starch, gum, etc.)	Fat Found	Fat Guaranteed, not less than
	WHEAT PRODUCTS—*Continued.*										
	Wheat Bran—Continued.										
3024	*Pure.* Northwestern Consolidated Milling Co., Minneapolis, Minn.	*Danbury:* F. C. Benjamin	9.25	6.49	15.13	13.00	9.84	12.00	53.66	5.63	4.00
2886	*Ogilvie Pure.* Ogilvie Flour Mills Co., Montreal, Canada	*Guilford:* F. H. Rolf	8.53	5.79	15.50	15.00	10.19	11.50	54.66	5.33	3.50
2267	Pillsbury Flour Mills Co., Minneapolis, Minn.	*Litchfield:* Wadhams Co.	9.91	6.23	15.50	14.00	10.18	12.00	52.85	5.33	4.00
2895	*Bell Cow.* Quaker Oats Company, Peterborough, Canada	*Waterbury:* H. S. Coe & Co., Inc.	10.00	4.97	15.13	15.00	8.50	10.00	56.15	5.25	3.50
3532	*Red Wing Special.* Red Wing Milling Co., Red Wing, Minn.	*Willimantic:* Willimantic Grain Co.	6.75	5.91	15.13	13.50	9.70	15.60	57.06	5.45	4.10
2834	*Black Hawk.* Robin Hood Mills, Ltd., Moose Jaw and Calgary, Canada	*Seymour:* Seymour Grain & Coal Co.	8.95	5.67	16.56	15.00	9.55	11.50	52.89	6.38	3.50
2795	*Occident.* Russell Miller Milling Co., Minneapolis, Minn.	*Windsor:* Farmers' Grain & Supply Co.	10.41	5.77	15.63	14.00	9.14	11.50	53.25	5.80	4.00
2236	St. Lawrence Flour Mills, Montreal, Canada	*Hamden:* Ira W. Beers	12.19	5.13	15.94	15.00	9.04	11.50	52.59	5.11	3.50
2943	*Victor Spring.* Victor Flour Mills, Victor, N. Y.	*Guilford:* F. H. Rolf	8.68	5.83	15.25	16.00	9.30	11.00	55.69	5.25	4.00
2241	*Gold Medal.* Washburn-Crosby										

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1925—*Continued.*

Station No.	Manufacturer and Brand	Retail Dealer	Water	Ash	Protein N x 6.25: Found	Protein N x 6.25: Guaranteed, not less than	Fiber: Found	Fiber: Guaranteed, not more than	Nitrogen-free extract (starch, gum, etc.)	Fat: Found	Fat: Guaranteed, not less than
	WHEAT PRODUCTS—*Continued.*										
	Wheat Bran—Concluded.										
2296	*Pioneer.* Western Canada Flour Mills, Toronto, Canada	*Torrington:* Litchfield County Co-op.	8.90	5.55	16.19	15.00	9.80	11.50	53.76	5.80	3.50
	Wheat Middlings.										
2823	*Dandy.* Copeland Flour Mills, Midland, Canada	*Merrow:* I. F. Wilcox	11.50	3.54	17.63	16.00	5.73	8.00	56.05	5.55	5.00
3069	*Eagle.* Eagle Roller Mill Co., New Ulm, Minn.	*So. Norwalk:* Roodner Feed Co.	8.45	3.83	17.94	16.00	4.81	6.00	58.93	6.04	5.00
2769	*Elmore Snow.* Elmore Milling Co., Oneonta, N. Y.	*Thompsonville:* Geo. S. Phelps & Co.	10.43	3.59	16.88	16.00	5.35	7.00	58.46	5.29	4.25
2291	*Special.* Fairchild Milling Co., Cleveland, Ohio	*Seymour:* Seymour Grain & Coal Co.	10.79	3.25	15.88	15.00	4.23	8.00	61.90	3.95	3.50
2292	*Standard.* Fairchild Milling Co., Cleveland, Ohio	*Seymour:* Seymour Grain & Coal Co.	9.83	4.54	17.06	13.00	7.10	9.00	55.81	5.66	4.00
3061	*Dairy Maid.* Federal Mill & Elevator Co., Lockport, N. Y.	*Putnam:* Bosworth Bros.	9.25	3.68	16.88	15.50	4.81	6.00	60.60	4.78	4.50
3166	*Superior.* Flory Milling Co., Bangor, Pa.	*Thomaston:* I. Levey	11.08	3.55	15.25	14.00	4.59	8.00	60.24	5.29	3.00
•2940	*Rainbow.* The Galt Flour Mills, Galt, Canada	*New Hartford:* Geo. W. Case	9.29	4.58	18.88	16.00	7.63	8.00	52.44	7.18	5.00

Pounds per Hundred (Water through Fat)

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1925—*Continued.*

Station No.	Manufacturer and Brand	Retail Dealer	Water	Ash	Protein N x 6.25 Found	Protein Guaranteed, not less than	Fiber Found	Fiber Guaranteed, not more than	Nitrogen-free extract (starch, gum, etc.)	Fat Found	Fat Guaranteed, not less than
	WHEAT PRODUCTS—*Continued.*										
	Wheat Middlings—Continued.										
2289	Wm. Hamilton & Son, Honeoye Falls, N. Y.	*Derby:* Peterson-Hendee Co.	11.35	3.15	15.63	14.90	3.15	5.40	62.59	4.13	4.90
3330	Wm. Hamilton & Son, Honeoye Falls, N. Y.	*Derby:* Peterson-Hendee Co.	9.58	4.10	17.38	14.90	4.50	5.40	59.24	5.20	4.90
2211	*H.* Hecker-Jones-Jewell Milling Co., New York City	*West Cheshire:* G. W. Thorpe	10.65	4.39	16.00	14.00	7.03	9.50	56.78	5.15	5.00
3028	Hecker-Jones-Jewell Milling Co., New York City	*Stratford:* Farmers' Flour & Grain Co.	9.42	4.91	17.38	15.00	7.38	9.50	54.38	6.53	4.75
2298	*Rex.* Maple Leaf Milling Co., Toronto, Canada	*Granby:* E. H. Rollins	9.30	4.27	17.69	15.00	6.95	9.50	55.36	6.43	5.00
2772	*Choice.* Niagara Falls Milling Co., Niagara Falls, N. Y.	*Derby:* Peterson-Hendee Co.	9.88	3.70	17.44	15.50	5.44	9.50	57.94	5.60	4.00
3023	Northwestern Consolidated Milling Co., Minneapolis, Minn.	*Danbury:* C. S. Barnum & Son.	8.98	4.23	17.63	15.00	5.93	6.00	56.70	6.53	4.00
2781	Northwestern Consolidated Milling Co., Minneapolis, Minn.	*Windsor:* Farmers' Grain & Supply Co.	8.85	4.25	15.88	15.00	8.01	9.50	56.61	6.40	4.00
2885	*Ogilvie's.* Ogilvie Flour Mills, Winnepeg, Canada	*Branford:* S. V. Osborn Estate.	10.13	3.99	16.94	16.00	6.25	8.00	57.30	5.39	5.00
2921	Park & Pollard Co., Buffalo, N. Y.	*Westerly:* C. W. Campbell Co.	9.88	2.95	14.44	16.00	4.43	6.00	64.12	4.18	4.00

Pounds per Hundred

Table I. Analyses of Commercial Feeds, Inspection of 1925—*Continued.*

Station No.	Manufacturer and Brand	Retail Dealer	Water	Ash	Protein N x 6.25: Found	Protein N x 6.25: Guaranteed, not less than	Fiber: Found	Fiber: Guaranteed, not more than	Nitrogen-free extract (starch, gum, etc.)	Fat: Found	Fat: Guaranteed, not less than
	Wheat Products—*Continued.*										
	Wheat Middlings—Concluded.										
2270	Pillsbury Mills, Minneapolis, Minn.	*Torrington:* Litchfield County Co-op. Assoc.	10.03	3.37	17.81	16.00	4.02	6.00	59.93	4.84	4.00
2268	*Standard B.* Pillsbury Mills, Minneapolis, Minn.	*Torrington:* Litchfield County Co-op. Assoc.	10.53	3.88	16.63	15.00	5.93	9.50	57.86	5.17	4.00
2894	*Bell Cow.* Quaker Oats Co., Peterborough, Canada	*Waterbury:* H. S. Coe & Co., Inc.	9.44	3.98	17.13	15.00	6.00	8.00	57.51	5.94	4.00
2838	*Black Hawk.* Robin Hood Mills, Ltd., Moose Jaw and Calgary, Canada	*Waterbury:* Spencer Grain Co.	10.24	8.58	18.25	17.00	6.83	8.00	49.72	6.38	5.00
2796	*Alto.* Russell Miller Milling Co., Minneapolis, Minn.	*Windsor:* Farmers' Grain & Supply Co.	9.50	4.16	17.81	15.00	5.89	8.50	56.19	6.45	4.50
2237	*Wirthmore.* St. Albans Grain Co., St. Albans, Vt.	*Hamden:* Ira W. Beers	10.35	3.46	16.13	14.00	5.43	8.00	59.65	4.98	4.00
2942	*Victor Spring.* Victor Flour Mills, Victor, N. Y.	*Guilford:* F. H. Rolf	8.76	4.25	17.00	17.65	6.10	9.50	58.04	5.85	5.00
2959	*Gold Medal.* Washburn-Crosby Co., Minneapolis, Minn.	*Norwich:* Norwich Grain Co.	10.56	3.19	15.38	16.00	3.73	6.00	62.55	4.59	4.00
2240	*Gold Medal.* Washburn-Crosby Co., Minneapolis, Minn.	*Plantsville:* C. A. Cowles	10.38	4.31	16.44	15.00	7.36	9.50	55.50	6.01	4.00
2969	*Big Y.* Yantic Grain & Products Co., Norwich	*Moosup:* Moosup Grain Co.	9.25	3.81	17.38	17.00	5.00	5.00	59.48	5.08	5.00

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1925—*Continued.*

Station No.	Manufacturer and Brand	Retail Dealer	Water	Ash	Protein N x 6.25 Found	Protein Guaranteed, not less than	Fiber Found	Fiber Guaranteed, not more than	Nitrogen-free extract (starch, gum, etc.)	Fat Found	Fat Guaranteed, not less than
			Pounds per Hundred								
	WHEAT PRODUCTS—*Continued.*										
	Wheat Red Dog.										
3070	*Eagle.* Eagle Roller Mill Co., New Ulm, Minn.	*So. Norwalk:* Roodner Feed Co.	9.11	2.96	18.00	16.50	2.65	3.50	61.78	5.50	4.50
2252	*Red Dog Flour.* Hecker-Jones-Jewell Mill. Co., New York	*Torrington:* D. L. Talcott	10.15	3.22	16.75	15.75	3.63	4.00	60.92	5.33	5.00
2777	*Red Dog Flour.* Hecker-Jones-Jewell Mill. Co., New York	*Wallingford:* A. E. Hall	10.58	2.29	16.94	15.00	1.73	4.00	64.73	3.73	4.25
2809	*Gold Medal Adrian Red Dog.* Washburn-Crosby Co., Minneapolis, Minn.	*Thompsonville:* Geo. S. Phelps & Co.	10.51	1.94	16.81	16.00	1.90	4.00	65.16	3.68	4.00
3193	*Gold Medal Adrian Red Dog.* Washburn-Crosby Co., Minneapolis, Minn.	*Norwich:* Yantic Grain & Products Co.	10.24	2.81	17.13	16.00	2.15	4.00	62.92	4.75	4.00
	Wheat Feed. (Mixed Feed.)										
3191	*Wingold.* Bay State Milling Co., Winona, Minn.	*Danbury:* F. C. Benjamin	9.45	4.19	16.56	16.20	4.98	8.10	60.37	4.45	4.20
3108	*Boston.* Duluth Superior Milling Co., Duluth, Minn.	*Manchester:* Manchester Grain Co.	8.25	4.53	15.13	15.00	7.58	9.50	58.81	5.70	4.00
3060	*Dairy Maid.* Federal Mill & Elevator Co., Lockport, N. Y.	*Putnam:* Bosworth Bros.	9.73	5.39	16.13	15.50	6.85	8.00	57.32	4.58	4.00

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1925 *Continued.*

Station No.	Manufacturer and Brand	Retail Dealer	Water	Ash	Protein N x 6.25: Found	Protein: Guaranteed, not less than	Fiber: Found	Fiber: Guaranteed, *not more than*	Nitrogen-free extract (starch, gum, etc.)	Fat: Found	Fat: Guaranteed, not less than
	WHEAT PRODUCTS—*Continued.*										
	Wheat Feed. (Mixed Feed)—Continued.										
2247	*Gold Mine.* H. H. King Flour Mills Co., Minneapolis, Minn.	*Derby:* Peterson-Hendee Co. ...	10.85	4.85	15.50	15.00	7.83	9.50	55.53	5.44	4.50
2259	*Red Star.* E. Manchester & Sons, Winsted	*Winsted:* E. Manchester & Sons	10.20	4.12	16.63	15.50	6.40	7.50	57.33	5.32	4.00
2774	*Bull.* Maritime Milling Co., Buffalo, N. Y.	*New Milford:* Geo. E. Ackley Co.	9.95	4.71	16.38	15.00	6.80	8.00	56.28	5.88	4.00
2780	*Red Wing.* Meech & Stoddard, Inc., Middletown	*East Hartford:* Meech Grain Co.	9.05	5.18	15.88	15.00	7.24	10.00	57.27	5.38	4.50
3522	*Moon's.* George O. Moon & Co., Binghamton, N. Y.	*Thomaston:* Cunningham & Wallace	7.88	5.59	16.63	14.00	7.58	10.00	57.89	4.43	4.00
3036	*Osota.* National Milling Co., Toledo, Ohio	*Suffield:* Spencer Bros.	9.35	5.32	16.19	15.00	7.88	10.00	55.58	5.68	4.50
2871[4]	*Choice.* Niagara Falls Milling Co., Niagara Falls, N. Y.	*Torrington:* F. W. Wadhams ..	9.30	4.63	15.63	14.50	6.90	8.00	58.00	5.54	4.00
2881	*Planet.* Northwestern Consolidated Milling Co., Minneapolis, Minn.	*So. Coventry:* E. W. Latimer ..	10.86	4.61	16.25	15.00	6.03	8.00	57.08	5.17	4.00
3126	Northwestern Consolidated Milling Co., Minneapolis, Minn. ..	*Kensington:* S. F. Labieniec	10.73	4.96	16.50	15.00	7.12	8.50	55.19	5.50	4.00

[4] Registered after March 1st, 1926.

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1925—*Continued.*

Station No.	Manufacturer and Brand	Retail Dealer	Pounds per Hundred: Water	Ash	Protein N x 6.25: Found	Protein: Guaranteed, not less than	Fiber: Found	Fiber: Guaranteed, not more than	Nitrogen-free extract (starch, gum, etc.)	Fat: Found	Fat: Guaranteed, not less than
	WHEAT PRODUCTS—*Concluded.*										
	Wheat Feed. (Mixed Feed)—Concluded.										
2880	*XXX Comet.* Northwestern Consolidated Milling Co., Minneapolis, Minn.	*Bloomfield:* Bloomfield Farmers' Exchange	10.25	2.77	17.38	16.00	1.85	4.00	62.67	5.08	4.00
2926	*Pretty Special.* Park & Pollard Co., Buffalo, N. Y.	*Woodbury:* C. L. Adams Co.	9.53	4.94	15.88	16.00	7.78	9.00	55.59	6.28	4.00
2786	*Pillsbury's.* Pillsbury Flour Mills, Minneapolis, Minn.	*New Milford:* Geo. T. Soule	10.54	3.51	18.50	15.00	4.17	8.50	57.86	5.42	4.00
2272	*XX Daisy.* Pillsbury Flour Mills, Minneapolis, Minn.	*Canaan:* Ives & Pierce	10.30	2.65	18.13	16.00	2.43	4.00	61.83	4.66	4.00
2221	*Occident.* Russell Miller Milling Co., Minneapolis, Minn.	*Ansonia:* Ansonia Flour & Feed Co.	10.48	4.69	16.25	15.00	7.43	9.50	55.28	5.87	4.50
2278	*Wirthmore.* St. Albans Grain Co., St. Albans, Vt.	*Kent:* Kent Grain & Coal Co.	10.18	4.76	15.63	15.00	6.25	8.00	58.80	4.38	4.50
2927	*Or-Co.* Tioga Mill & Elevator Co., Waverly, N. Y.	*Hawleyville:* W. A. Honan	9.48	5.79	17.00	15.00	7.45	10.00	55.78	4.50	5.00
2242	*Gold Medal.* Washburn-Crosby Co. Minneapolis, Minn.	*Watertown:* Watertown Coöp. Assoc.	10.55	4.04	15.94	16.00	5.21	7.50	60.18	4.08	4.00
2793	*Big Y.* Yantic Grain & Products Co., Norwich	*Norwich:* Yantic Grain & Products Co.	8.95	4.56	15.88	16.00	8.04	7.00	57.37	5.20	4.50

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1925 *Continued.*

Station No.	Manufacturer and Brand	Retail Dealer	Water	Ash	Protein N x 6.25: Found	Protein: Guaranteed, not less than	Fiber: Found	Fiber: Guaranteed, not more than	Nitrogen-free extract (starch, gum, etc.)	Fat: Found	Fat: Guaranteed, not less than
	(Pounds per Hundred)										
	RYE PRODUCTS.										
3095	***Irving Mills*** VanVechten Milling Co., Rochester, N. Y.	*Higganum:* Felix A. Petrofsky..	8.36	3.74	17.13	13.00	4.10	10.00	63.14	3.53	2.00
2266	Miner-Hillard Milling Co., Wilkes-Barre, Penn.	*Torrington:* F. W. Wadhams ..	9.03	3.66	15.31	12.00	3.68	5.00	64.37	3.05	2.50
	MAIZE PRODUCTS.										
	Corn Gluten Feed.										
3188	American Maize Products Co., New York	*Bloomfield:* Bloomfield Farmers' Exchange	6.28	3.57	24.63	23.00	8.35	8.50	54.11	3.06	2.00
3153	***Clinton.*** Clinton Corn Syrup Refining Co., Clinton, Iowa	*Seymour:* Seymour Grain & Coal Co.	7.75	4.53	25.63	23.00	6.68	8.50	51.45	3.96	2.00
2208	***Buffalo.*** Corn Products Refining Co., New York	*Hamden:* Ira W. Beers	10.10	5.39	25.00	23.00	7.58	8.50	49.05	2.88	2.00
2839	***Keokuk.*** J. C. Hubinger Bros Co., Keokuk, Iowa	*Winsted:* E. Manchester & Sons	8.73	3.17	23.50	23.00	6.88	8.50	52.87	4.85	2.00
3162	***Douglas.*** Penick & Ford, Ltd., Inc., Cedar Rapids, Iowa	*New London:* Paty Schwartz Co.	9.10	6.05	25.00	23.00	7.60	8.00	49.31	2.85	1.00
3116	***Staley's.*** A. E. Staley Mfg. Co., Decatur, Ill.	*Derby:* Peterson-Hendee Co. ...	8.10	6.03	24.56	23.00	6.54	8.00	52.83	1.94	1.00

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1925—*Continued.*

Station No.	Manufacturer and Brand	Retail Dealer	Pounds per Hundred: Water	Ash	Protein N x 6.25: Found	Protein: Guaranteed, not less than	Fiber: Found	Fiber: Guaranteed, not more than	Nitrogen-free extract (starch, gum, etc.)	Fat: Found	Fat: Guaranteed, not less than
	MAIZE PRODUCTS—*Continued.*										
	Corn Gluten Meal.										
2245	*Diamond.* Corn Products Refining Co., New York	*Torrington:* D. L. Talcott	9.53	1.32	41.94	40.00	2.89	4.00	41.93	2.39	1.00
3098	*Douglas.* Penick & Ford, Inc., Cedar Rapids, Iowa	*Woodbury:* C. L. Adams Co.	6.90	2.87	43.44	40.00	3.23	4.00	41.68	1.88	1.00
	Corn Feed Meal.										
2925	Park & Pollard Co., Buffalo, N. Y.	*Seymour:* Klaridis Bros.	10.78	1.78	9.94	9.00	4.18	4.00	68.98	4.34	2.50
2977	*Derby.* Tioga Mill & Elevator Co., Waverly, N. Y.	*Hawleyville:* W. A. Honan	9.70	1.75	9.88	9.02	3.10	3.50	70.93	4.64	3.06
	Hominy Feed.										
2210	Aunt Jemima Mills Co., St. Joseph, Mo.	*Cheshire:* G. W. Thorpe	10.70	2.92	11.25	10.00	4.60	8.00	64.81	5.72	5.00
2950	*Homco.* Decatur Milling Co., Decatur, Ill.	*Wallingford:* A. E. Hall	9.55	2.44	10.50	10.00	5.03	6.00	65.80	6.68	7.00
3182	*Homco.* Decatur Milling Co., Decatur, Ill.	*Branford:* S. V. Osborn Estate.	10.15	2.43	10.50	10.00	4.30	6.00	65.22	7.40	7.00
2929	*Emco.* Evans Milling Co., Indianapolis, Ind.	*New Haven:* Moran-Patton Co.	9.13	2.60	10.69	10.00	4.61	6.00	67.84	5.13	7.00

Station No.	Manufacturer and Brand	Retail Dealer	Water	Ash	Protein N x 6.25 Found	Protein Guaranteed, not less than	Fiber Found	Fiber Guaranteed, not more than	Nitrogen-free extract (starch, gum, etc.)	Fat Found	Fat Guaranteed, not less than
	Maize Products—*Concluded.*										
	Hominy Feed—Concluded.										
2233	*K. B. C.* Kellogg Company, Battle Creek, Mich.	*Plantsville:* C. A. Cowles	9.15	2.11	10.50	10.00	3.78	5.00	68.52	5.94	6.00
2799	*Sonny South.* Louisville Milling Co., Louisville, Ky.	*Hamden:* Ira W. Beers	7.98	3.05	11.63	10.00	5.43	6.00	64.85	7.06	7.00
3081	*Bufceco.* Mapl-Flake Mills, Inc., Chicago, Ill.	*New Hartford:* Geo. W. Case	9.03	2.90	10.94	10.00	3.90	6.00	67.30	5.93	5.00
2251	*Steam-cooked.* Miner-Hillard Milling Co., Wilkes-Barre, Penn.	*Torrington:* F. W. Wadhams	10.73	2.33	10.38	10.00	4.05	5.00	68.13	4.38	4.00
2224	Patent Cereals Co., Geneva, N. Y.	*Seymour:* Seymour Grain & Coal Co.	10.30	2.54	10.44	10.00	4.68	5.00	67.54	4.50	5.00
2790	*Burt's.* Postum Cereal Co., Inc., Battle Creek, Mich.	*Collinsville:* F. W. Konold	10.36	1.97	10.13	10.00	2.78	5.00	70.03	4.73	6.00
2872	*White.* Quaker Oats Company, Chicago, Ill.	*Litchfield:* Wadhams Co.	8.88	1.94	10.25	10.50	4.72	6.00	69.27	4.94	5.00
2897	*Yellow.* Quaker Oats Company, Chicago, Ill.	*Watertown:* Watertown Coöp. Assoc.	8.33	2.55	11.06	10.50	4.45	6.00	67.98	5.63	5.00
3063	*Paragon.* St. Albans Grain Co., St. Albans, Vt.	*Danielson:* Quinebaug Mills	9.44	2.89	10.69	10.00	3.65	7.00	67.44	5.89	6.00
3118	David Stott Flour Mills, Detroit, Mich.	*New London:* Paty Schwartz Co.	9.93	2.09	10.63	9.50	3.84	7.50	67.67	5.84	5.50
2949	*Gold Medal.* Washburn-Crosby Minneapolis, Minn.	*Winsted:* Chas. R. Hawley	9.80	2.30	10.31	10.00	3.47	6.00	68.42	5.70	5.00

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1925—*Continued.*

Station No.	Manufacturer and Brand	Retail Dealer	Water	Ash	Protein N x 6.25 Found	Protein Guaranteed, not less than	Fiber Found	Fiber Guaranteed, not more than	Nitrogen-free extract (starch, gum, etc.)	Fat Found	Fat Guaranteed, not less than
	BREWERS' AND DISTILLERS' PRODUCTS.										
3075	*Alco.* Dried Distillers' Grains. C. J. Martenis Grain Co., Produce Exchange, New York	*Seymour:* Seymour Grain & Coal Co.	5.80	1.43	**23.50**	25.00	10.89	13.00	48.95	9.43	5.50
3077	*Ricormalt.* Waterloo Distilling Corp., Waterloo, N. Y.	*Plantsville:* C. A. Cowles	3.76	3.65	**26.81**	28.00	9.85	14.00	46.19	**9.74**	10.00
	DRIED BEET PULP.										
2232	Larrowe Milling Co., Detroit, Mich.	*West Cheshire:* G. W. Thorpe ..	8.83	2.80	9.38	8.00	18.23	22.00	60.01	0.75	0.50
	PROPRIETARY MIXED FEEDS.										
	Horse Feed.										
3083	*Beacon.* Beacon Milling Co., Cayuga, N. Y.	*Danbury:* C. S. Barnum & Son.	7.46	3.89	10.44	9.00	7.53	11.00	67.39	3.29	2.50
2830	·*Provender.* C. W. Campbell Co., Westerly, R. I.	*Westerly:* C. W. Campbell Co...	10.75	2.42	10.56	10.00	7.38	8.00	64.76	4.13	4.00
2297	*Co-Pro-Co.* Corn Products Refining Co., New York	*Kent:* Kent Grain & Coal Co. ..	7.94	4.93	9.63	9.00	10.30	12.00	64.30	2.90	2.50
3017	*Davis.* R. G. Davis & Sons, New Haven	*Glenbrook:* Davis-Scofield Co. ..	8.84	4.07	9.88	9.00	7.68	10.00	66.11	3.42	3.00

Station No.	Manufacturer and Brand	Retail Dealer	Pounds per Hundred: Water	Ash	Protein N x 6.25: Found	Protein: *Guaranteed*, not less than	Fiber: Found	Fiber: *Guaranteed*, not more than	Nitrogen-free extract (starch, gum, etc.)	Fat: Found	Fat: Guaranteed, not less than
	PROPRIETARY MIXED FEEDS—*Continued.*										
	Horse Feed—Continued.										
2931	*No. 1 Provender.* R. G. Davis & Sons, New Haven	*New Haven:* R. G. Davis & Sons	10.10	2.55	11.00	10.00	7.52	6.00	64.71	4.12	4.50
3198	*No. 1 Provender.* R. G. Davis & Sons, New Haven	*Westville:* R. G. Davis & Sons..	10.19	2.50	10.63	10.00	7.83	6.00	65.10	3.75	4.50
2199	*Alfalfa Meal.* Denver Alfalfa Mill & Products Co., Lamar, Col.	*Derby:* Peterson-Hendee Co. ...	7.68	8.52	14.38	12.00	29.48	35.00	37.91	2.03	1.00
2836	*Eastern States.* Eastern States Farmers' Exch., Springfield, Mass.	*Seymour:* John Swan	9.24	3.05	14.06	12.00	4.83	9.00	64.32	4.50	4.00
2817	*Lancaster 60.* John W. Eshelman & Son, Lancaster, Pa. ...	*Simsbury:* Woods-Chandler Co.	8.23	4.94	11.63	9.00	10.53	10.00	61.53	3.14	2.50
2203	*Red Rose 85.* John W. Eshelman & Son, Lancaster, Pa. ...	*Seymour:* Seymour Grain & Coa Co.	1.00	3.73	10.81	9.00	8.25	10.00	62.11	4.10	3.00
3067	*"Ata Boy."* Flory Milling Co., Bangor, Penn.	*So. Norwalk:* Roodner Feed Co.	5.53	8.77	7.88	5.00	9.68	15.00	67.26	0.88	1.50
3068	*Blue Mountain.* Flory Milling Co., Bangor, Penn.	*So. Norwalk:* Roodner Feed Co.	6.63	9.05	8.00	7.00	10.18	11.00	63.69	2.45	2.00
•3140	*Hunter.* Grain Belt Mills Co., St. Joseph, Mo.	*New Haven:* R. G. Davis & Sons	8.70	5.69	11.63	9.00	8.38	14.00	63.35	2.25	2.00

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1925—*Continued.*

Station No.	Manufacturer and Brand	Retail Dealer	Water	Ash	Protein N x 6.25 Found	Protein Guaranteed, not less than	Fiber Found	Fiber Guaranteed, not more than	Nitrogen-free extract (starch, gum, etc.)	Fat Found	Fat Guaranteed, not less than
	PROPRIETARY MIXED FEEDS—*Continued.*										
	Horse Feeds—Continued										
2958	Dwight Hamlin Co., Pittsburgh, Penn.	*Norwich:* Yantic Grain & Products Co.	6.49	6.59	10.81	12.00	10.96	10.00	64.00	1.15	2.00
2860	*Algrane.* Hecker H. O. Co., Buffalo, N. Y.	*Westerly:* C. W. Campbell Co.	8.98	5.10	11.63	11.00	10.03	9.75	60.53	3.73	4.00
3186	*Algrane.* Hecker H. O. Co., Buffalo, N. Y.	*Westerly:* C. W. Campbell Co.	8.90	5.01	10.19	11.00	11.00	9.75	61.05	3.85	4.00
3135	*Imperial.* Imperial Grain & Milling Co., Toledo, Ohio	*East Hartford:* Meech Grain Co.	9.15	2.31	9.75	9.50	5.85	4.00	68.51	4.43	4.00
3015	*Nabob.* Francis H. Leggitt Co., Stamford	*Stamford:* Francis H. Leggitt Co.	8.90	5.02	11.25	9.00	10.31	10.00	61.57	2.95	2.50
3041	*Armour's.* Mapl-Flake Mills, Inc., Chicago, Ill.	*Stamford:* W. L. Crabb	8.30	5.47	13.88	11.00	11.00	9.00	57.02	4.33	4.00
3047[3]	*Oat.* Mapl-Flake Mills, Chicago, Ill.	*New Haven:* R. G. Davis & Sons	5.38	6.15	4.63	5.50	26.20	30.00	56.36	1.28	1.50
3529	*Red Wing.* Meech & Stoddard, Inc., Middletown	*East Hartford:* Meech Grain Co.	8.53	3.70	11.38	9.00	7.75	10.00	64.24	4.40	3.00
3523	*Old Times.* Geo. O. Moon & Co., Binghamton, N. Y.	*Thomaston:* Cunningham & Wallace	8.58	2.64	11.13	8.50	7.09	9.00	66.33	4.23	4.50

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Station No.	Manufacturer and Brand	Retail Dealer	Water	Ash	Protein N x 6.25 Found	Protein Guaranteed, not more than	Fiber Found	Fiber Guaranteed, not less than	Nitrogen-free extract (starch, gum, etc.)	Fat Found	Fat Guaranteed, not less than
	Pounds per Hundred										
	Proprietary Mixed Feeds—*Continued.*										
	Horse Feeds—Continued.										
2849	*Provender.* Fred C. Morse, Guilford	*Guilford:* Fred C. Morse	10.85	2.31	11.06	9.00	4.49	5.00	66.69	4.60	3.00
3169	*Domino.* Vim-O-Lene. Nowak Milling Corp., Hammond, Ind.	*Waterville:* Wooster Feed Store	9.01	3.07	9.69	8.00	5.20	9.00	69.55	3.48	2.00
2882	*Osborn Provender.* S. V. Osborn Estate, Branford	*Branford:* S. V. Osborn Estate.	9.68	2.44	11.06	10.00	8.55	8.00	64.29	3.98	4.00
2778	*Arlington.* Park & Pollard Co., Buffalo, N. Y.	*Plainville:* F. B. Newton	7.73	4.44	10.88	9.00	6.94	11.00	66.61	3.40	2.50
2218	*Belmont.* Park & Pollard Co., Buffalo, N. Y.	*Shelton:* Shelton Feed Co.	3.45	4.81	10.75	10.00	6.00	12.00	66.56	3.43	2.00
2228	*Chelsea.* Park & Pollard Co., Buffalo, N. Y.	*Waterbury:* Spencer Grain Co.	8.15	8.10	7.50	8.00	11.92	12.00	63.24	1.09	2.00
2915	*Corn and Oats, ½ & ½.* Park & Pollard Co., Buffalo, N. Y.	*Colchester:* P. Cutler, Inc.	10.33	2.91	11.81	10.00	6.80	8.00	63.92	4.23	1.50
3189	*Arab.* M. C. Peter's Mill Co., Omaha, Neb.	*Hartford:* C. A. Pease	6.50	5.97	12.31	10.00	12.43	15.00	60.01	2.78	2.00
2976	*Vim Feed.* Quaker Oats Co., Chicago, Ill.	*New London:* Paty Schwartz Co.	5.08	6.62	7.88	5.00	23.73	28.00	53.91	2.78	2.00
3086	*Purina O Molene.* Ralston Purina Mill, St. Louis, Mo.	*New Haven:* Moran-Patton Co.	7.63	4.27	11.94	9.70	8.24	9.00	64.13	3.79	3.20

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1925—*Continued.*

Station No.	Manufacturer and Brand	*Retail Dealer*	Pounds per Hundred: Water	Ash	Protein N x 6.25: Found	Protein: Guaranteed, not less than	Fiber: Found	Fiber: Guaranteed, not more than	Nitrogen-free extract (starch, gum, etc.)	Fat: Found	Fat: Guaranteed, not less than
	PROPRIETARY MIXED FEEDS—*Continued.*										
	Horse Feeds—Concluded.										
2995	*Rosebro.* Rosenbaum Bros., Chicago, Ill.	*Stratford:* M. Blakely	8.78	7.60	10.13	10.00	12.45	15.00	58.31	2.73	2.00
2979	*Derby.* Tioga Mill & Elevator Co., Waverly, N. Y.	*Bethel:* Morrison & Dunham	8.10	5.38	11.00	10.00	12.25	12.00	50.25	3.72	3.00
2286	*Ground Corn and Oats, ½ & ½.* United Flour & Feed Co., Albany, N. Y.	*Winsted:* Chas. R. Hawley	10.03	2.20	11.10	10.00	5.80	7.00	65.69	4.10	4.00
	Dairy Feeds.										
2954	*Advanced Registry.* Arcady Farms Milling Co., Chicago, Ill.	*Simsbury:* Woods-Chandler Co.	7.30	6.70	26.00	25.00	9.48	10.00	44.76	5.70	5.00
2953	*Peerless.* Arcady Farms Milling Co., Chicago, Ill.	*Simsbury:* Woods-Chandler Co.	7.78	7.42	20.81	20.00	11.04	12.00	46.41	5.64	4.00
3183	*Capitol.* E. W. Bailey & Co., Swanton, Vt.	*New London.* B. J. McCarthy	8.98	5.33	24.50	24.00	6.95	9.00	48.69	5.55	5.00
2825	*Favorite.* E. W. Bailey & Co., Swanton, Vt.	*Merrow:* I. F. Wilcox	10.13	4.35	20.06	20.00	6.70	9.00	53.98	4.78	5.00
2205	*Beers Dairy Ration.* Ira W. Beers, Hamden	*Hamden:* Ira W. Beers	10.60	4.78	20.44	19.00	7.03	8.00	51.67	5.48	3.75

Station No.	Manufacturer and Brand	Retail Dealer	Pounds per Hundred: Water	Ash	Protein N x 6.25: Found	Protein: Guaranteed, not less than	Fiber: Found	Fiber: Guaranteed, not more than	Nitrogen-free extract (starch, gum, etc.)	Fat: Found	Fat: Guaranteed, not less than
	PROPRIETARY MIXED FEEDS—*Continued.*										
	Dairy Feeds—Continued.										
2820	*Success Dairy Ration.* Amos D. Bridges Sons, Inc., Hazardville, Conn.	*Hazardville:* Amos D. Bridges Sons, Inc.	8.83	4.16	21.38	20.00	8.70	9.30	51.85	5.08	5.20
2826	*No-Botheration Dairy Ration.* C. W. Campbell Co., Westerly, R. I.	*Westerly:* C. W. Campbell Co...	9.50	4.41	20.63	20.00	6.20	8.00	53.82	5.44	5.00
2294	*Ajax Dairy Ration.* Chapin & Co., Chicago, Ill.	*West Cheshire:* G. W. Thorpe ..	7.83	6.87	22.00	20.00	9.23	12.00	48.32	5.75	4.50
2295	*Unicorn Dairy Ration.* Chapin & Co., Chicago, Ill.	*West Cheshire:* G. W. Thorpe ..	7.63	7.24	24.75	24.00	8.55	10.00	46.16	5.67	5.00
3147	*Conkey's Dairy Ration.* G. E. Conkey Co., Cleveland, Ohio ..	Mfr's. Sample	6.44	5.48	23.56	24.00	7.80	9.00	51.77	4.95	5.00
3146	*Gecco Dairy Ration.* G. E. Conkey Co., Cleveland, Ohio ..	Mfr's. Sample	6.55	5.84	21.19	20.00	7.15	9.00	54.09	5.18	4.50
3145	*Red Seal Dairy Ration.* G. E. Conkey Co., Cleveland, Ohio..	Mfr's. Sample	6.57	12.20	17.19	16.00	7.80	10.00	51.06	4.28	3.50
2212	*Cowles' Dairy Ration.* C. A. Cowles, Plantsville, Conn.	*Plantsville:* C. A. Cowles	8.73	4.85	26.56	24.00	8.30	10.00	45.82	5.74	6.00
3151	*Crosby's Balanced Ration.* Crosby Milling Co., Brattleboro, Vt...	*Shelton:* Wolf Savitsky	8.78	5.41	27.56	25.00	8.52	11.00	44.14	5.59	5.50

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1925—*Continued.*

Station No.	Manufacturer and Brand	Retail Dealer	Water	Ash	Protein N x 6.25: Found	Protein N x 6.25: Guaranteed, not less than	Fiber: Found	Fiber: Guaranteed, not more than	Nitrogen-free extract (starch, gum, etc.)	Fat: Found	Fat: Guaranteed, not less than
	PROPRIETARY MIXED FEEDS—*Continued.*										
	Dairy Feeds—Continued.										
3331	*Crosby's 22 Dairy Feed.* Crosby Milling Co., Brattleboro, Vt.	*Shelton:* Wolf Savitsky	8.23	6.27	22.69	22.00	10.64	14.00	47.21	4.96	4.00
3332	*Crosby's Ready Ration.* Crosby Milling Corp., Brattleboro, Vt.	*Shelton:* Wolf Savitsky	9.60	5.70	22.06	20.00	7.75	10.00	49.74	5.15	5.00
2945	*King Dairy Ration.* The Cutler Co., No. Wilbraham, Mass.	*Willimantic:* Willimantic Grain Co.	7.75	7.58	22.38	22.00	9.20	12.00	49.09	4.00	5.00
3192	*King Dairy Ration.* The Cutler Co., No. Wilbraham, Mass.	*Norwich:* Norwich Grain Co.	8.44	8.13	22.88	22.00	8.78	12.00	47.24	4.53	5.00
2200	*Basic Dairy Ration.* R. G. Davis & Sons, New Haven	*Shelton:* Shelton Feed Co.	9.58	4.98	19.81	20.00	8.30	9.00	52.38	4.95	5.00
3009	*Delaware Dairy Feed.* Delaware Mills, Inc., Deposit, N. Y.	*Southington:* Southington Lumber & Feed Co.	8.35	5.18	22.50	23.00	9.20	10.00	49.12	5.65	5.00
3105	*Devon Dairy Ration.* Devon Coal & Ice Co., Devon, Conn.	*Devon:* Devon Coal & Ice Co.	7.89	5.42	19.25	20.00	9.99	8.00[1]	52.26	5.19	5.00
2835	*Full Pail Dairy Ration.* Eastern States Farmers' Exchange, Springfield, Mass.	*Seymour:* John Swan	8.38	6.23	22.44	20.00	7.13	9.00	50.98	4.84	4.00

[1] Minimum. Law requires maximum to be given.

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1925—*Continued.*

Station No.	Manufacturer and Brand	Retail Dealer	Water	Ash	Protein N x 6.25 Found	Protein Guaranteed, not less than	Fiber Found	Fiber Guaranteed, not more than	Nitrogen-free extract (starch, gum, etc.)	Fat Found	Fat Guaranteed, not less than
			Pounds per Hundred								
	PROPRIETARY MIXED FEEDS—*Continued.*										
	Dairy Feeds—Continued.										
2858	*Fitting Dairy Ration.* Eastern States Farmers' Exchange, Springfield, Mass.	*Putnam:* Calvin Poore	8.38	3.90	13.50	12.00	6.23	8.00	63.14	4.85	3.50
2856	*Milkmore Dairy Ration.* Eastern States Farmers' Exchange, Springfield, Mass.	*Putnam:* Calvin Poore	8.53	6.02	25.44	24.00	7.93	9.00	46.93	5.15	4.50
2254	*Elmore Milk Grains.* Elmore Milling Co., Oneonta, N. Y.	*Torrington:* Litchfield County Co-op. Assoc.	8.43	5.41	25.50	25.00	9.44	11.00	46.09	5.13	6.00
3125	*Elmore Milk Grains.* Elmore Milling Co., Oneonta, N. Y.	*Kensington:* S. F. Labieniec	8.44	4.79	25.00	25.00	9.08	11.00	47.50	5.[illegible]9	6.00
2202	*Eshelman's Lancaster 20 Dairy Feed.* John W. Eshelman & Sons, Lancaster, Penn.	*Seymour:* Seymour Grain & Coal Co.	10.10	6.51	19.50	20.00	10.15	10.00	48.51	5.23	4.00
2816	*Eshelman's Susquehanna Dairy Feed.* John W. Eshelman & Sons, Lancaster, Penn.	*Plainville:* F. B. Newton	9.29	5.18	20.19	20.00	9.66	12.00	50.47	5.21	3.00
3100	*Eshelman's Red Rose Dairy Feed.* John W. Eshelman & Sons, Lancaster, Penn.	*Greenwich:* Johnson's Feed Store	7.41	6.87	23.50	24.00	10.05	10.00	46.32	5.85	4.00
2843	Dairy Ration. A. W. Forbes, East Haven	*East Haven:* A. W. Forbes	8.78	5.30	21.69	19.00	10.00	9.00	50.38	3.85	4.00

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1925 *Continued.*

Station No.	Manufacturer and Brand	Retail Dealer	Water	Ash	Protein N × 6.25 Found	Protein Guaranteed, not less than	Fiber Found	Fiber Guaranteed, not more than	*Nitrogen-free extract* (starch, gum, etc.)	Fat Found	Fat Guaranteed, not less than
	PROPRIETARY MIXED FEEDS—*Continued.*										
	Dairy Feeds—Continued.										
3325	Dairy Ration. A. W. Forbes, East Haven	*East Haven:* A. W. Forbes	9.50	4.78	22.63	19.00	7.67	9.00	51.32	4.10	4.00
2855	*Grandin's 12 Twin Six.* D. H. Grandin Milling Co., Jamestown, N. Y.	*Willimantic:* Willimantic Grain Co.	8.75	5.34	22.81	22.00	7.09	12.00	49.77	5.34	5.00
2859	*Grandin's 24% Balanced Dairy Ration.* D. H. Grandin Milling Co., Jamestown, N. Y.	*Norwich:* Norwich Grain Co.	9.03	5.14	24.13	24.00	8.15	10.00	48.25	5.30	5.00
2234	*Larro*—The Ready Ration for Dairy Cows. Larrowe Milling Co., Detroit, Mich.	*Plantsville:* C. A. Cowles	8.83	5.54	20.31	20.00	10.51	12.00	50.53	4.28	4.00
3013	*Nabob Dairy Feed.* Francis H. Leggett Co., Stamford, Conn.	*Stamford:* Francis H. Leggett Co.	7.75	7.45	22.06	18.00	11.03	10.00	46.79	4.92	4.50
3336	*Nabob Dairy Feed.* Francis H. Leggett Co., Stamford, Conn.	*Stamford:* Francis H. Leggett Co.	9.32	6.80	19.81	18.00	10.48	10.00	48.34	5.25	3.50
3004	*Premier Dairy Feed.* Francis H. Leggett Co., Stamford, Conn.	*Stamford:* Francis H. Leggett Co.	8.38	5.34	26.38	25.00	8.49	10.00	45.75	5.66	5.50
3568	*Uniform Brand Dairy Ration.* C. W. Lines Co., New Britain	*New Britain:* C. W. Lines Co.	8.85	1.67	26.13	24.00	6.98	10.00	50.87	5.50	5.50
2257	*Red Star Dairy Feed.* E. Manchester & Son, Winsted, Conn.	*Winsted:* E. Manchester & Sons	8.45	6.22	24.38	23.00	7.88	10.00	46.32	6.75	4.00

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1925—*Continued.*

Station No.	Manufacturer and Brand	Retail Dealer	Pounds per Hundred								
			Water	Ash	Protein N x 6.25		Fiber		Nitrogen-free extract (starch, gum, etc.)	Fat	
					Found	Guaranteed, not less than	Found	Guaranteed, not more than		Found	Guaranteed, not less than
	PROPRIETARY MIXED FEEDS—*Continued.*										
	Dairy Feeds—Continued.										
2260	*Red Star Special Dairy Feed.* E. Manchester & Son, Winsted ..	*Winsted:* E. Manchester & Sons	8.25	6.15	21.50	22.00	8.73	10.00	48.79	6.58	4.50
3042	*Armour's 24% Dairy Feed.* Mapl-Flake Mills, Chicago, Ill.	*Danbury:* C. S. Barnum & Son.	7.44	7.84	23.88	24.00	11.13	12.00	45.08	4.63	5.00
3046	*Iroquois 20% Dairy Feed.* Mapl-Flake Mills, Chicago, Ill.	*Danbury:* H. E. Meeker	7.70	9.46	19.63	20.00	11.42	11.00	47.11	4.68	4.00
2249	*Bull Brand Dairy Ration.* Maritime Milling Co., Buffalo, N. Y.	*Thomaston:* Cunningham & Wallace	9.58	7.21	23.75	24.00	10.27	12.00	43.81	5.38	6.00
3121	*Bull Brand Dairy Ration.* Maritime Milling Co., Buffalo, N. Y.	*Wealogue:* R. B. Eno	8.68	7.56	24.00	24.00	10.00	12.00	43.58	6.18	6.00
840	*Hi Test Dairy Feed.* Maritime Milling Co., Buffalo, N. Y. ..	*North Haven:* Wm. L. Thorpe..	7.83	7.43	20.50	20.00	12.82	14.00	46.24	5.18	5.00
3530	*Red Wing Special Dairy Ration* (without Brewers' Grains). Meech & Stoddard, Inc., Middletown	*Middletown:* Meech & Stoddard, Inc.	6.98	6.20	24.25	24.00	8.15	9.00	48.82	5.60	5.50
3531	*Red Wing Dairy Ration* (without Brewers' Grains). Meech & Stoddard, Inc., Middletown	*Meriden:* Meriden Grain & Coal Co.	6.60	6.25	22.13	20.00	8.23	9.00	51.34	5.45	5.50

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1925—*Continued.*

Station No.	Manufacturer and Brand	Retail Dealer	Pounds per Hundred								
			Water	Ash	Protein N x 6.25		Fiber		Nitrogen-free extract (starch, gum, etc.)	Fat	
					Found	Guaranteed, not less than	Found	Guaranteed, not more than		Found	Guaranteed, not less than
	PROPRIETARY MIXED FEEDS—*Continued.*										
	Dairy Feeds—Continued.										
3574	*Red Wing Dairy Ration 20%.* Meech & Stoddard, Inc., Middletown	*East Hartford:* Meech Grain Co.	9.13	5.43	23.38	20.00	8.85	9.00	47.66	5.55	5.50
3573	*Red Wing Dairy Ration 24%.* Meech & Stoddard, Inc., Middletown	*East Hartford:* Meech Grain Co.	8.75	6.04	24.19	24.00	8.85	9.00	45.29	6.88	5.50
2848	*Old Mill Dairy Ration.* Fred C. Morse, Guilford, Conn.	*Guilford:* Fred C. Morse	8.78	6.52	23.75	20.00	7.60	10.00	47.40	5.95	5.00
3179	*Domino Butterine Dairy Feed.* Nowak Milling Corp., Hammond, Ind.	*Waterville:* Wooster Feed Store	7.74	12.11	18.13	17.00	10.18	15.00	46.34	5.50	3.50
3161	*Domino 24½ Dairy Feed.* Nowak Milling Corp., Hammond, Ind.	*Higganum:* Felix A. Petrofsky	8.65	8.30	24.81	24.50	7.50	10.00	45.79	4.95	4.50
3178	*Fidelity Dairy Feed.* Nowak Milling Corp., Hammond, Ind.	*Waterville:* Wooster Feed Store	8.95	7.13	20.25	20.00	8.75	11.00	50.38	4.54	4.00
3094	*Hammond Dairy Feed.* Nowak Milling Corp., Hammond, Ind.	*Higganum:* Felix A. Petrofsky	8.13	11.67	17.88	16.50	10.30	13.50	46.02	6.00	4.00
3177	*Marathon Dairy Feed.* Nowak Milling Corp., Hammond, Ind.	*Waterville:* Wooster Feed Store	7.83	7.23	22.00	22.00	9.15	12.00	48.35	5.44	4.00

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1925—*Continued.*

Station No.	Manufacturer and Brand	Retail Dealer	Pounds per Hundred								
					Protein N x 6.25		Fiber			Fat	
			Water	Ash	Found	Guaranteed, not less than	Found	*Guaranteed,* not more than	Nitrogen-free extract (starch, *gum,* etc.)	Found	Guaranteed, not less than
	PROPRIETARY MIXED FEEDS—*Continued.*										
	Dairy Feeds—Continued.										
2773	*Uncle John's 24% Cream Pot Ration.* Ontario Milling Co., Oswego, N. Y.	*New Milford:* W. L. Richmond & Son	9.03	5.48	23.38	24.00	7.42	9.00	48.70	5.99	5.50
2910	*Economy Feed.* Park & Pollard Co., Buffalo, N. Y.	*West Stafford:* C. P. Bradway & Son	8.85	7.19	19.50	20.00	7.55	10.00	52.56	4.35	5.00
3136	*Economy Feed.* Park & Pollard Co., Buffalo, N. Y.	*Moosup:* T. E. Maine & Sons	7.83	8.50	19.69	20.00	8.88	10.00	47.22	7.88	5.00
3062	*Milk Maid 24% Dairy Ration.* Park & Pollard Co., Buffalo, N. Y.	*Putnam:* Bosworth Bros.	7.18	7.86	24.50	24.00	10.79	11.00	44.64	5.03	5.00
2285	*Steven's "44" Sweetened Dairy Ration.* Park & Pollard Co., Buffalo, N. Y.	*Waterbury:* Spencer Grain Co.	8.85	7.33	25.31	24.00	7.22	14.00	45.89	5.40	5.00
2229	*Steven's Milkade Calf Meal.* Park & Pollard Co., Buffalo, N. Y.	*Waterbury:* Spencer Grain Co.	8.28	7.98	23.69	20.00	5.19	7.50	47.06	7.80	8.00
2914	*Universal Ration.* Park & Pollard Co., Buffalo, N. Y.	*Moosup:* T. E. Maine & Sons Co.	9.03	9.50	18.31	16.00	9.75	12.00	45.83	7.58	6.00
2269	Dairy Ration. Pillsbury Mills, Minneapolis, Minn.	*Torrington:* Litchfield County Co-op. Assoc.	8.73	6.71	20.63	20.00	9.03	12.00	50.07	4.83	5.00

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1925—*Continued.*

Station No.	Manufacturer and Brand	Retail Dealer	Water	Ash	Protein N x 6.25: Found	Protein N x 6.25: Guaranteed, not less than	Fiber: Found	Fiber: Guaranteed, not more than	Nitrogen-free extract (starch, gum, etc.)	Fat: Found	Fat: Guaranteed, not less than
	PROPRIETARY MIXED FEEDS—*Continued.*										
	Dairy Feeds—Continued.										
3536	*Burt's Cereal Feed.* Postum Cereal Co., Battle Creek, Mich.	*Weatogue:* R. B. Eno	4.98	4.51	20.31	17.00	14.85	20.00	51.10	4.25	3.00
3119	*Burt's Dairy Ration.* Postum Cereal Co., Battle Creek, Mich.	*Weatogue:* R. B. Eno	7.01	5.94	24.63	24.00	6.20	9.00	51.59	4.63	5.00
2791	*Producer Dairy Feed.* H. C. Puffer Co., Springfield, Mass.	*Simsbury:* Woods-Chandler Co.	9.39	5.79	23.13	24.00	6.99	8.50	49.52	5.18	4.00
3122	*Producer Dairy Feed.* H. C. Puffer Co., Springfield, Mass.	*Bloomfield:* Bloomfield Farmers' Exchange	9.18	5.67	25.00	24.00	6.85	8.50	48.74	4.56	4.00
3103	*Big Q Dairy Ration.* Quaker Oats Co., Chicago, Ill.	*Highwood:* T. C. Hadden & Co.,	6.92	7.36	20.63	20.00	11.50	12.00	49.39	4.20	3.25
2898	*Boss Dairy Ration.* Quaker Oats Co., Chicago, Ill.	*New Milford:* W. L. Richmond & Son	8.38	6.96	24.25	24.00	8.88	10.50	46.70	4.83	4.00
3091	*Protena Dairy Feed.* Ralston Purina Mills, St. Louis, Mo.	*Hartford:* Olds & Whipple, Inc.	7.18	7.76	17.81	16.50	12.93	12.00	50.39	3.93	3.50
3000	*Purina Cow Chow Feed.* Ralston Purina Mills, St. Louis, Mo.	*Stamford:* W. L. Crabb	7.20	6.62	25.69	24.00	10.00	12.00	45.96	4.53	4.30
2873	*Purina Legume Cow Chow.* Ralston Purina Mills, St. Louis, Mo.	*Litchfield:* Wadhams Co.	8.94	5.21	21.81	20.00	6.55	8.00	52.28	5.21	3.80

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1925 - *Continued.*

Station No.	Manufacturer and Brand	Retail Dealer	Water	Ash	Protein N x 6.25 Found	Protein Guaranteed, not less than	Fiber Found	Fiber Guaranteed, not more than	Nitrogen-free extract (starch, gum, etc.)	Fat Found	Fat Guaranteed, not less than
	PROPRIETARY MIXED FEEDS—*Continued.*										
	Dairy Feeds—Continued.										
2908	*Advance Dairy Feed.* Rosenbaum Bros., Chicago, Ill.	*Stafford Springs:* Dennis Grain Mill	8.81	8.09	16.31	16.00	11.20	14.00	46.79	7.90	3.50
2996	*Vitality Dairy Feed.* Rosenbaum Bros., Chicago, Ill.	*East Bridgeport:* Kaplan Feed Co.	7.60	7.61	25.81	24.00	8.63	10.00	45.17	5.18	5.00
2997	*Will Pay Dairy Ration.* Rosenbaum Bros., Chicago, Ill.	*East Bridgeport:* Kaplan Feed Co.	8.38	7.89	23.25	20.00	8.70	9.00	46.30	5.48	5.00
3096	*Homespun Dairy Ration.* The Paty Schwartz Co., New London	*New London:* Paty Schwartz Co.	7.84	6.51	23.06	22.00	10.50	10.00	48.02	4.07	5.00
2788	*Mill Stream Boomerang Dairy Feed.* Winchell Smith, Inc., Farmington, Conn.	*Farmington:* Winchell Smith, Inc.	9.40	4.23	24.00	24.00	6.65	10.00	50.28	5.35	6.00
2787	*Mill Stream Twenty Per Cent Dairy Ration.* Winchell Smith, Inc., Farmington, Conn.	*Farmington:* Winchell Smith, Inc.	9.36	5.96	23.06	20.00	8.00	8.00	49.34	5.18	5.00
2890	*"See-More" Milk Dairy Ration.* Seymour Grain & Coal Co., Seymour, Conn.	*Seymour:* Seymour Grain & Coal Co.	9.03	6.45	21.25	20.00	8.18	9.00	49.96	5.13	4.50

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1925—*Continued.*

Station No.	Manufacturer and Brand	Retail Dealer	Water	Ash	Protein N x 6.25: Found	Protein N x 6.25: Guaranteed, not less than	Fiber: Found	Fiber: Guaranteed, not more than	Nitrogen-free extract (starch, gum, etc.)	Fat: Found	Fat: Guaranteed, not less than
	PROPRIETARY MIXED FEEDS—*Continued.*										
	Dairy Feeds—Continued.										
2264	*Paragon Dairy Feed.* St. Albans Grain Co., St. Albans, Vt.	*Thomaston:* Cunningham & Wallace	8.83	6.36	20.31	22.00	10.63	12.00	49.08	4.79	4.00
3181	*Paragon Dairy Feed.* St. Albans Grain Co., St. Albans, Vt.	*Newtown:* R. H. Holcomb & Co.	8.05	7.26	22.00	22.00	10.95	12.00	46.73	5.01	4.00
2277	*Wirthmore Balanced Ration for Dairy Cows.* St. Albans Grain Co., St. Albans, Vt.	*Lakeville:* E. W. Spurr Co.	8.15	6.72	24.38	25.00	8.58	9.00	46.21	5.96	5.50
2263	*Wirthmore 20% Dairy Feed.* St. Albans Grain Co., St. Albans, Vt.	*Watertown:* Watertown Coöp. Assoc.	9.66	5.72	23.00	20.00	7.23	9.00	49.01	5.38	5.00
2288	*Syragold Milk Ration.* Syracuse Milling Co., Syracuse, N. Y...	*Norfolk:* Aug. P. Curtis	9.34	5.00	19.94	20.00	8.95	12.00	51.93	4.84	4.00
2279	*Syragold Dairy Feed.* Syracuse Milling Co., N. Y.	*Torrington:* F. W. Wadhams ..	8.40	5.17	24.75	24.00	9.35	12.00	46.98	5.35	4.50
2803	*Red Brand Tioga Dairy Feed.* Tioga Mill & Elevator Co., Waverly, N. Y.	*New Milford:* Geo. T. Soule ...	8.50	6.49	26.00	24.00	8.53	10.00	44.58	5.90	4.50
2941	*Union Grains Biles Ready Dairy Ration.* Ubiko Milling Co., Cincinnati, Ohio	*Hartford:* C. A. Pease	8.20	6.18	24.00	24.00	8.68	10.00	47.26	5.68	5.00

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1925—*Continued.*

Station No.	Manufacturer and Brand	Retail Dealer	Pounds per Hundred: Water	Ash	Protein N x 6.25: Found	Protein: Guaranteed, not less than	Fiber: Found	Fiber: Guaranteed, not more than	Nitrogen-free extract (starch, gum, etc.)	Fat: Found	Fat: Guaranteed, not less than
	PROPRIETARY MIXED FEEDS—*Continued.*										
	Dairy Feeds—Concluded.										
2285	*United Dairy Ration.* United Flour & Feed Co., Albany, N. Y.	*Winsted:* Chas. R. Hawley	9.20	5.80	23.38	24.00	8.44	11.00	47.98	5.20	5.00
3120	*United Dairy Ration.* United Flour & Feed Co., Albany, N. Y.	*Weatogue:* R. B. Eno	8.65	5.19	24.13	24.00	9.00	11.00	47.63	5.40	5.00
2912	*Big Y Dairy Ration.* Yantic Grain & Products Co., Norwich, Conn.	*Willimantic:* Boston Grain Co.	8.53	5.85	25.25	25.00	7.24	10.00	47.59	5.54	5.00
2972	*Echo Dairy Feed.* Yantic Grain & Products Co., Norwich, Conn.	*Norwich:* Yantic Grain & Products Co.	7.18	7.14	24.88	24.00	11.29	12.00	44.53	4.98	4.50
2975	*Perfection Dairy Feed.* Yantic Grain & Products Co., Norwich, Conn.	*Norwich:* Yantic Grain & Products Co.	7.18	7.05	22.50	22.00	12.52	13.00	45.33	5.42	4.50
2970	*Uncas Dairy Feed.* Yantic Grain & Products Co., Norwich, Conn.	*Moosup:* Moosup Grain Co.	8.48	5.65	21.00	20.00	6.83	9.00	52.89	5.15	5.00

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1925—*Continued.*

Station No.	Manufacturer and Brand	Retail Dealer	Water	Ash	Protein N x 6.25 Found	Protein Guaranteed, not less than	Fiber Found	Fiber Guaranteed, not more than	*Nitrogen-free extract* (starch, gum, etc.)	Fat Found	Fat Guaranteed, not less than
			Pounds per Hundred								
	PROPRIETARY MIXED FEEDS—*Continued.*										
	Stock Feeds.										
2822	*Pennant Stock Feed.* E. W. Bailey & Co., Swanton, Vt. ..	*Mansfield Depot:* Martin M. Hansen	8.97	4.51	9.13	9.00	10.31	10.00	62.64	4.44	5.00
2828	*No-Botheration Stock Feed.* C. W. Campbell Co., Westerly, R. I.	*Westerly:* C. W. Campbell Co...	8.56	5.57	14.25	12.00	9.08	10.00	57.61	4.93	4.00
3150	*Crosby's Stock Food.* Crosby Milling Co., Brattleboro, Vt...	*Shelton:* Wolf Savitsky	8.90	4.21	10.25	9.00	9.69	12.00	62.68	4.27	4.00
3016	*Davis Stock Feed.* R. G. Davis & Sons, New Haven	*Glenbrook:* Davis-Scofield Co...	8.35	4.91	11.63	10.00	10.43	14.00	61.04	3.64	2.00
3008	*Delaware Stock Feed.* Delaware Mills, Inc., Deposit, N. Y.	*Southington:* Southington Lumber & Feed Co.	8.36	4.85	10.06	9.00	11.60	12.00	60.50	4.63	3.00
3107	*Devon Sweet Stock Feed.* Devon Coal & Ice Co., Devon, Conn..	*Devon:* Devon Coal & Ice Co...	8.08	5.02	10.00	8.00	13.40	12.00	59.81	3.69	2.50
3099	*Eshelman's Stock Feed.* John W. Eshelman & Sons, Lancaster, Penn.	*Greenwich:* Johnson's Feed Store	7.02	3.70	9.63	10.00	10.73	10.00	63.19	5.73	3.00
2841	*Eshelman's Sugared Stock Feed.* John W. Eshelman & Sons, Lancaster, Penn.	*So. Manchester:* Smith Bros. ..	8.43	5.35	11.50	10.00	13.72	11.00	57.52	3.48	3.25

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1925—*Continued.*

Station No.	Manufacturer and Brand	Retail Dealer	Pounds per Hundred: Water	Ash	Protein N x 6.25: Found	Protein: Guaranteed, not less than	Fiber: Found	Fiber: Guaranteed, not more than	Nitrogen-free extract (starch, gum, etc.)	Fat: Found	Fat: Guaranteed, not less than
	PROPRIETARY MIXED FEEDS—*Continued.*										
	Stock Feeds—Continued.										
3065	*Globe Cow Feed.* Flory Milling Co., Bangor, Penn.	*Bridgeport:* Connecticut Feed Co.	5.65	5.47	**18.94**	20.00	8.13	11.00	57.40	4.41	4.00
2842	*Flory's Special Stock Feed.* Flory Milling Co., Bangor, Penn.	*Bloomfield:* Bloomfield Farmers' Exch.	8.27	6.10	8.06	8.00	**16.50**	14.00	58.57	**2.50**	3.00
3138	*Flory's Stock Feed.* Flory Milling Co., Bangor, Penn.	*Fairfield:* Samp Mortar Mills	7.34	5.60	8.50	8.00	**16.25**	14.00	58.88	3.43	3.00
2854	*Grandin's Stock Feed.* D. H. Grandin Milling Co., Jamestown, N. Y.	*Willimantic:* Willimantic Grain Co.	9.83	3.40	9.75	9.00	8.36	12.00	63.73	4.93	5.00
3012	*Algrane Milk Feed.* Hecker H. O. Company, Inc., Buffalo, N. Y.	*So. Norwalk:* Roodner Feed Co.	7.48	6.42	16.00	16.00	11.33	15.00	55.04	**3.73**	4.00
3335	*Algrane Milk Feed.* Hecker H. O. Company, Inc., Buffalo, N. Y.	*So. Norwalk:* Roodner Feed Co.	7.80	6.45	17.63	16.00	12.60	15.00	51.49	4.03	4.00
2861	*Algrane New England Stock Feed.* Hecker H. O. Co., Buffalo, N. Y.	*Westerly:* C. W. Campbell Co.	8.58	5.34	12.13	9.50	9.70	9.75	60.07	4.18	4.00

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1925—*Continued.*

Station No.	Manufacturer and Brand	Retail Dealer	Pounds per Hundred: Water	Ash	Protein N x 6.25: Found	Protein: Guaranteed, not less than	Fiber: Found	Fiber: Guaranteed, not more than	Nitrogen-free extract (starch, gum, etc.)	Fat: Found	Fat: Guaranteed, not less than
	PROPRIETARY MIXED FEEDS—*Continued.*										
	Stock Feeds—Continued.										
3071	*Badger Stock Feed.* Chas. A. Kraus Milling Co., Milwaukee, Wis.	*Stamford:* Francis H. Leggett Co.	6.13	6.66	10.50	10.00	17.74	12.00	55.02	3.95	3.00
3014	*Nabob Stock Feed.* Francis H. Leggett Co., Stamford, Conn.	*Stamford:* Francis H. Leggett Co.	8.20	3.93	9.75	10.00	10.85	10.00	63.59	3.68	3.00
3043	*Iroquois Chop Feed.* Mapl-Flake Mills, Chicago, Ill.	*Danbury:* C. S. Barnum & Son.	8.69	5.34	9.00	8.00	10.63	12.00	62.04	4.30	4.00
3080	*Iroquois Stock Feed.* Mapl-Flake Mills, Inc., Chicago, Ill.	*New Milford:* Geo. E. Ackley Co.	7.41	6.38	12.88	10.00	12.65	13.00	56.43	4.25	4.00
2783	*Red Wing Special Stock.* Meech & Stoddard, Inc., Middletown, Conn.	*Meriden:* Meriden Grain & Coal Co.	8.28	6.02	9.75	9.00	9.54	12.00	62.41	4.00	3.00
2782	*Red Wing Stock Feed.* Meech & Stoddard, Inc., Middletown, Conn.	*Middletown:* Meech & Stoddard, Inc.	8.44	5.73	9.31	9.00	9.10	12.00	63.64	3.78	3.00
3030	*Fidelity Stock Feed.* Nowak Milling Corp., Hammond, Ind.	*Higganum:* Felix A. Petrofsky.	8.61	3.97	8.19	8.00	11.40	12.00	64.25	3.58	3.00
2227	*Park & Pollard Co. Stock Feed.* Park & Pollard Co., Buffalo, N. Y.	*Waterbury:* Spencer Grain Co.	9.03	6.38	8.94	8.00	9.44	12.00	62.27	3.94	2.50

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1925—*Continued.*

Station No.	Manufacturer and Brand	Retail Dealer	Pounds per Hundred: Water	Ash	Protein N x 6.25: Found	Protein: Guaranteed, not less than	Fiber: Found	Fiber: Guaranteed, not more than	Nitrogen-free extract (*starch, gum, etc.*)	Fat: Found	Fat: Guaranteed, not less than
	PROPRIETARY MIXED FEEDS—*Continued.*										
	Stock Feeds—Continued										
3038	*Pratt's Supreme Stock Feed.* Pratt's Food Co., Philadelphia, Penn.	*New Britain:* S. P. Strople	8.90	3.35	9.50	9.00	8.97	12.00	65.59	3.69	3.00
3090	*Purina Steer Fatena Feed.* Ralston Purina Mills, St. Louis, Mo.	*Hartford:* Olds & Whipple, Inc.	7.40	7.95	13.75	12.00	7.54	7.50	59.86	3.50	2.00
2877	*Richford White Diamond Stock Feed.* Quaker Oats Co., Chicago, Ill.	*So. Manchester:* Smith Bros.	7.75	5.60	8.75	9.00	12.98	14.00	60.27	4.65	3.00
2896	*Sugared Schumachers Feed.* Quaker Oats Co., Chicago, Ill.	*Waterbury:* H. S. Coe & Co., Inc.	8.10	6.74	11.31	10.00	10.22	12.00	59.85	3.78	3.25
2904	*77 Stock Feed.* Rosenbaum Bros., Chicago, Ill.	*Stafford Springs:* Dennis Grain Mill	8.13	7.07	9.50	9.00	13.08	15.00	58.24	3.98	3.50
3566	*Vitality Stock Feed.* Rosenbaum Bros., Chicago, Ill.	*New Britain:* S. P. Strople	9.58	12.51	9.00	9.00	10.75	12.00	54.46	3.70	3.00
2924	*Homespun Stock Feed.* Paty Schwartz Co., New London	*New London:* Paty Schwartz Co.	6.93	5.44	9.19	9.00	12.10	10.00	61.56	4.78	4.00
2968	*Charlestock Feed.* St. Albans Grain Co., St. Albans, Vt.	*Danielson:* Quinebaug Mills	8.60	3.87	9.50	9.00	11.50	14.00	62.80	3.73	4.00

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1925—*Continued.*

Station No.	Manufacturer and Brand	Retail Dealer	Water	Ash	Protein N x 6.25: Found	Protein: Guaranteed, not less than	Fiber: Found	Fiber: Guaranteed, not more than	Nitrogen-free extract (starch, gum, etc.)	Fat: Found	Fat: Guaranteed, not less than
	PROPRIETARY MIXED FEEDS—*Continued.*										
	Stock Feeds—Concluded.										
2276	*Wirthmore Stock Feed.* St. Albans Grain Co., St. Albans, Vt.	*Lakeville:* E. W. Spurr Co.	8.51	3.78	9.63	9.00	8.73	9.50	63.61	5.71	4.00
2806	*Syragold Stock Feed.* Syracuse Milling Co., Syracuse, N. Y.	*Granby:* E. H. Rollins	8.90	4.49	10.44	9.00	10.68	12.00	61.20	4.29	3.00
2944	*Gold Medal Stock Feed.* Washburn-Crosby Co., Minneapolis, Minn.	*West Stafford:* C. P. Bradway & Sons	7.68	6.58	10.75	12.00	12.53	12.00	57.58	4.88	3.00
	Calf Feed, etc.										
2262	*Blatchford's Calf Meal.* Blatchford's Calf Meal Co., Waukegan, Ill.	*Lakeville:* E. W. Spurr Co.	9.80	7.89	24.31	24.00	5.45	6.75	47.02	5.53	5.00
2255	*Elmore Calf Meal.* Elmore Milling Co., Oneonta, N. Y.	*Torrington:* Litchfield County Coöp. Assoc.	9.49	4.91	25.50	24.00	4.19	4.00	51.69	4.22	4.00
3092	*Purina Calf Feed.* Ralston Purina Mills, St. Louis, Mo.	*Middletown:* H. G. Wadhams	9.00	4.97	27.75	27.00	3.60	4.50	51.11	3.57	3.20
2889	*Purina Pig Chow.* Ralston Purina Mills, St. Louis, Mo.	*Derby:* Peterson-Hendee Co.	9.23[1]	8.35	21.50	20.00	6.23	7.00	51.05	3.64	3.20

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1925—*Continued.*

Station No.	Manufacturer and Brand	Retail Dealer	Pounds per Hundred: Water	Ash	Protein N x 6.25: Found	Protein: Guaranteed, not less than	Fiber: Found	Fiber: Guaranteed, not more than	Nitrogen-free extract (*starch, gum, etc.*)	Fat: Found	Fat: Guaranteed, not less than
	PROPRIETARY MIXED FEEDS—*Continued.*										
	Poultry Feed.										
3184	*Pennant Scratch Feed.* E. W. Bailey & Co., Swanton, Vt.	*New London:* B. J. McCarthy ..	12.11	1.60	11.00	10.00	3.53	6.50	68.38	3.38	3.00
3139	*No. 455 Scratch Grains.* Basic Feeds Co. Lockport, Ill.	*Stamford:* W. L. Crabb	9.70	1.51	12.88	12.00	1.64	3.00	70.44	3.83	4.00
2938	*Beacon Egg Mash.* Beacon Milling Co., Inc., Cayuga, N. Y. ..	*New Milford:* W. L. Richmond & Son	8.40	9.64	22.00	22.00	4.95	7.00	49.35	5.66	4.50
3101	*Beacon Laying Mash.* Beacon Milling Co., Cayuga, N. Y.	*Danbury:* C. S. Barnum & Son.	7.30	10.22	21.63	20.00	6.70	8.00	47.21	6.94	5.00
2206	*Beers' Laying Mash.* Ira W. Beers, Hamden, Conn.	*Hamden:* Ira W. Beers	10.25	8.59	22.19	22.00	5.90	7.00	47.27	5.80	6.00
2207	*Beers' Scratch Feed.* Ira W. Beers, Hamden, Conn.	*Hamden:* Ira W. Beers	12.38	1.76	10.31	9.00	3.50	4.00	68.85	3.20	4.00
3148	*Beers' Scratch Feed.* Ira W. Beers, Hamden, Conn.	*Hamden:* Ira W. Beers	12.23	1.75	10.94	9.00	2.93	4.00	68.90	3.25	4.00
2911	*Bidwell Dry Mash.* Black Rock Milling Corp., Black Rock, N. Y.	*West Stafford:* C. P. Bradway & Son.	8.83	9.52	21.00	18.00	5.94	12.00	50.87	3.84	1.50
2217	*Bidwell Scratch Feed.* Black Rock Milling Corp., Black Rock, N. Y.	*Shelton:* Shelton Feed Co.	11.50	1.62	10.13	10.00	2.83	5.00	70.62	3.30	1.50

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1925—*Continued.*

Station No.	Manufacturer and Brand	Retail Dealer	Water	Ash	Protein N x 6.25 Found	Protein Guaranteed, not less than	Fiber Found	Fiber Guaranteed, not more than	Nitrogen-free extract (starch, gum, etc.)	Fat Found	Fat Guaranteed, not less than
	PROPRIETARY MIXED FEEDS—*Continued.*										
	Poultry Feed—Continued.										
3011	*Buckingham's Dry Mash.* C. Buckingham & Co., Southport, Conn.	*Southport:* C. Buckingham & Co.	8.81	8.78	19.00	19.00	5.78	8.00	51.49	6.14	5.00
2827	*Egg-O Scratch Feed.* C. W. Campbell Co., Westerly, R. I.	*Westerly:* C. W. Campbell Co...	11.35	1.54	10.69	10.00	2.58	5.00	71.34	2.50	3.00
3187	*Egg-O Scratch Feed.* C. W. Campbell Co., Westerly, R. I.	*Westerly:* C. W. Campbell Co...	11.81	1.44	10.38	10.00	2.60	5.00	71.02	2.75	3.00
2829	*Egg-O Dry Mash.* C. W. Campbell Co., Westerly, R. I.	*Westerly:* C. W. Campbell Co...	8.62	10.77	20.06	18.00	7.10	10.00	47.42	6.03	3.00
3338	*Albert Angell Jr.'s Growing Mash.* Coles Co., Middletown	*Middletown:* Coles Co.	8.50	6.17	17.19	15.00	4.50	6.00	58.21	5.43	5.00
3339	*Albert Angell Jr.'s Egg Mash.* Coles Co., Middletown	*Middletown:* Coles Co.	8.48	10.12	21.13	20.00	5.04	8.00	49.28	5.95	4.00
3526	*Albert Angell Jr.'s Chick Starter.* Coles Co., Middletown	*New Milford:* W. L. Richmond & Son	6.75	12.36	16.88	15.00	4.73	5.00	54.00	5.28	5.00
3018	*Conkey's Buttermilk Meat and Bone Growing Mash.* G. E. Conkey Co., Cleveland, Ohio..	*New Canaan:* Clapboard Hill Farms	7.98	9.74	18.63	18.00	4.90	5.00	53.27	5.48	4.00

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1925—*Continued.*

Station No.	Manufacturer and Brand	Retail Dealer	Pounds per Hundred: Water	Ash	Protein N x 6.25: Found	Protein: Guaranteed, not less than	Fiber: Found	Fiber: Guaranteed, not more than	Nitrogen-free extract (starch, gum, etc.)	Fat: Found	Fat: Guaranteed, not less than
	PROPRIETARY MIXED FEEDS—*Continued.*										
	Poultry Feed—Continued.										
3019	*Conkey's Buttermilk Meat, Grain and Bone Laying Mash.* G. E. Conkey Co., Cleveland, Ohio..	*New Canaan:* Clapboard Hill Farms	9.18	8.71	20.25	20.00	5.58	6.00	50.60	5.68	5.00
3021	*Conkey's Buttermilk, Grain and Bone Starting Feed.* G. E. Conkey Co., Cleveland, Ohio..	*Ridgefield:* Ridgefield Lumber Co.	9.23	5.82	12.69	12.00	3.61	4.00	63.20	5.45	3.00
3020	*Conkey's Scratch Grains.* G. E. Conkey Co., Cleveland, Ohio ..	*Ridgefield:* Ridgefield Lumber Co.	11.64	1.61	11.06	9.75	2.53	3.00	70.38	2.78	1.75
2214	*C. A. Blue Seal Mash.* C. A. Cowles, Plantsville, Conn.	*Plantsville:* C. A. Cowles	9.60	9.24	20.13	18.00	4.60	6.00	50.75	5.68	4.00
2213	*C. A. Meato Mash.* C. A. Cowles, Plantsville, Conn.	*Plantsville:* C. A. Cowles	9.80	7.12	24.19	20.00	4.65	4.50	48.34	5.90	4.00
3152	*Crosby's Egg Mash.* Crosby Milling Co., Brattleboro, Vt...	*Shelton:* Wolf Savitsky	9.02	11.45	22.69	18.00	5.48	8.50	45.98	5.38	4.00
3149	*Crosby's Scratch Feed.* Crosby Milling Co., Brattleboro, Vt...	*Shelton:* Wolf Savitsky	11.92	1.55	10.50	11.00	3.28	5.00	69.53	3.22	3.00
2946	*King Mash Feed.* The Cutler Co., No. Wilbraham, Mass. ..	*Willimantic:* Willimantic Grain Co.	8.23	8.49	20.69	20.00	6.93	10.00	49.76	5.90	3.00
2947	*King Scratch Feed.* The Cutler Co., No. Wilbraham, Mass. ..	*Willimantic:* Willimantic Grain Co.	10.81	1.46	10.38	10.00	2.49	6.00	71.87	2.99	2.50

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1925—*Continued.*

Station No.	Manufacturer and Brand	Retail Dealer	Water	Ash	Protein N x 6.25: Found	Protein N x 6.25: Guaranteed, not less than	Fiber: Found	Fiber: Guaranteed, not more than	Nitrogen-free extract (starch, gum, etc.)	Fat: Found	Fat: Guaranteed, not less than
			Pounds per Hundred								
	PROPRIETARY MIXED FEEDS—*Continued.*										
	Poultry Feed—Continued.										
2201	*Davis Mash Feed.* R. G. Davis & Sons, New Haven, Conn...	*Ansonia:* Ansonia Flour & Feed Co.	9.48	6.16	18.13	18.00	6.50	7.00	53.75	5.98	5.00
3084	*Davis Scratch Feed.* R. G. Davis & Sons, New Haven, Conn...	*New Haven:* R. G. Davis & Sons	10.88	1.64	10.00	10.00	2.26	5.00	71.91	3.31	2.00
3007	*Delaware Chick Starting Mash.* Delaware Mills, Inc., Deposit, N. Y.	*Southington:* Southington Lumber & Feed Co.	8.75	8.79	21.88	15.00	4.48	5.00	49.65	6.45	4.00
2952	*Delaware "Intermediate Chick Grains.* Delaware Mills, Inc., Deposit, N. Y.	*Southington:* Southington Lumber & Feed Co.	12.30	1.39	9.81	10.00	1.80	5.00	72.17	2.53	2.00
2951	*Delaware Scratch Grains.* Delaware Mills, Inc., Deposit, N. Y.	*Southington:* Southington Lumber & Feed Co.	11.85	1.35	10.25	10.00	2.68	5.00	71.19	2.68	2.50
3106	*Devon Laying Mash.* Devon Coal & Ice Co., Devon, Conn.	*Devon:* Devon Coal & Ice Co...	8.51	8.23	21.00	18.00	4.88	7.00	52.28	5.10	5.00
2837	*Eastern States Scratch Grains* Eastern States Farmers' Exchange, Springfield, Mass. ...	*Seymour:* John Swan	10.60	1.69	11.06	10.00	2.83	4.50	70.72	3.10	3.00
2857	*Egg Mash.* Eastern States Farmers' Exchange, Springfield, Mass.	*Putnam:* Calvin Poore	8.75	7.72	22.38	20.00	6.35	7.00	49.77	5.03	3.50

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1925—*Continued.*

Station No.	Manufacturer and Brand	Retail Dealer	Pounds per Hundred								
			Water	Ash	Protein N x 6.25		Fiber		Nitrogen-free extract (starch, gum, etc.)	Fat	
					Found	Guaranteed, not less than	Found	Guaranteed, not more than		Found	Guaranteed, not less than
	PROPRIETARY MIXED FEEDS—*Continued.*										
	Poultry Feed—Continued.										
2818	*Elmore Scratch Feed.* Elmore Milling Co., Oneonta, N. Y.	*Thompsonville:* Geo. S. Phelps & Co.	11.79	1.33	10.13	10.00	2.65	5.00	71.35	2.75	3.50
2253	*Eshelman's Laying Mash.* John W. Eshelman & Son, Lancaster, Penn.	*Torrington:* D. L. Talcott	9.46	6.74	22.19	20.00	5.16	7.00	49.60	6.85	5.00
2244	*Eshelman's Scratch Feed.* John W. Eshelman & Son, Lancaster, Penn.	*Torrington:* D. L. Talcott	12.60	1.40	10.19	10.00	2.78	4.00	70.90	2.73	3.00
2819	*Imperial Scratch Feed.* John W. Eshelman & Son, Lancaster, Penn.	*Manchester:* W. A. Strant	11.50	1.39	9.94	9.00	2.53	4.00	71.93	2.71	3.00
3197	*Imperial Scratch Feed.* John W. Eshelman & Son, Lancaster, Penn.	*Hartford:* N. Y. Feed & Grain Co.	12.78	0.97	9.69	9.00	2.70	4.00	71.01	2.85	3.00
3123	*Flory's Superior Egg Mash.* Flory Milling Co., Bangor, Penn.	*Bloomfield:* Bloomfield Farmers' Exchange	8.98	6.41	19.50	20.00	7.93	8.00	51.64	5.54	5.50
3066	*Golden Egg Laying Mash.* Flory Milling Co., Bangor, Penn.	*Bridgeport:* Connecticut Feed Co.	8.13	6.95	18.50	18.00	9.54	10.00	51.68	5.20	4.00

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1925—*Continued.*

Station No.	Manufacturer and Brand	Retail Dealer	Water	Ash	Protein N x 6.25 Found	Protein N x 6.25 Guaranteed, not less than	Fiber Found	Fiber Guaranteed, not more than	Nitrogen-free extract (starch, gum, etc.)	Fat Found	Fat Guaranteed, not less than
			Pounds per Hundred								
	PROPRIETARY MIXED FEEDS—*Continued.*										
	Poultry Feed—Continued.										
3155	*Golden Egg Scratch Feed.* Flory Milling Co., Bangor, Penn.	*Thomaston:* I. Levy	11.76	1.72	10.56	10.00	3.08	5.00	69.57	3.31	3.00
2821	*Sunray Scratch Feed.* Flory Milling Co., Bangor, Penn.	*Bloomfield:* Bloomfield Farmers' Exchange	11.73	1.46	10.13	10.00	2.50	5.00	71.53	2.65	3.00
2844	Laying Mash. A. W. Forbes, East Haven, Conn.	*East Haven:* A. W. Forbes	8.75	8.88	25.00	20.00	4.94	6.00	46.60	5.83	5.00
2845	*R. Own Scratch Feed.* A. W. Forbes, East Haven, Conn.	*East Haven:* A. W. Forbes	11.48	1.67	9.75	10.00	2.94	5.00	70.86	3.30	3.00
3194	*Grandin's Baby Chick Feed.* D. H. Grandin Milling Co., Jamestown, N. Y.	*Willimantic:* Willimantic Grain Co.	11.83	1.45	11.06	10.00	1.40	5.00	70.88	3.38	2.50
3195	*Grandin's Baby Chick Starter with Buttermilk.* D. H. Grandin Milling Co., Jamestown, N. Y.	*Willimantic:* Willimantic Grain Co.	9.45	4.43	14.75	12.00	3.13	5.00	62.78	5.46	4.00
2853	*Grandin's Laying Mash with Buttermilk.* D. H. Grandin Milling Co., Jamestown, N. Y.	*Willimantic:* Willimantic Grain Co.	8.98	11.63	20.75	20.00	6.20	8.00	47.41	5.03	4.00

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1925—*Continued.*

Station No.	Manufacturer and Brand	Retail Dealer	Water	Ash	Protein (N x 6.25) Found	Protein (N x 6.25) Guaranteed, not less than	Fiber Found	Fiber Guaranteed, not more than	Nitrogen-free extract (starch, gum, etc.)	Fat Found	Fat Guaranteed, not less than
			Pounds per Hundred								
	PROPRIETARY MIXED FEEDS—*Continued.*										
	Poultry Feed—Continued.										
2852	*Grandin's Screened Scratch Feed.* D. H. Grandin Milling Co., Jamestown, N. Y.	*Merrow:* I. F. Wilcox	11.73	1.55	10.44	10.00	2.73	5.00	70.11	3.44	2.50
3097	*Red Comb Egg Mash with Dried Buttermilk.* Hales & Hunter Co., Chicago, Ill.	*New Britain:* Stanley-Svea Grain Co.	8.33	12.10	21.88	20.00	4.27	7.00	48.99	4.43	4.50
3102	*Red Comb Growing Mash.* Hales & Hunter Co., Chicago, Ill.	*Highwood:* T. C. Hadden & Co.	8.25	5.86	17.38	18.00	5.00	5.00	58.63	4.88	4.00
3575	*Hudson's Laying Mash.* L. W. Hudson, Windsor	*Windsor:* L. W. Hudson	9.78	10.87	19.19	19.79	6.30	6.95	48.11	5.75	5.62
3576	*Hudson's 50-50 Scratch.* L. W. Hudson, Windsor	*Windsor:* L. W. Hudson	11.15	1.60	11.00	11.38	2.75	3.48	70.37	3.13	3.35
3010	*Ingersoll's Special Egg Mash.* Z. C. Ingersoll, Stratford, Conn.	*Stratford:* Z. C. Ingersoll	7.75	10.99	17.00	18.31	8.48	8.44	49.42	6.36	6.45
3333	*Ingersoll's Special Egg Mash.* Z. C. Ingersoll, Stratford, Conn.	*Stratford:* Z. C. Ingersoll	8.73	10.50	17.88	18.31	8.16	8.44	48.65	6.08	6.45
3167	*Larro Egg Mash.* Larrowe Milling Co., Detroit, Mich.	*Bristol:* D. J. Minor	8.35	12.02	20.75	19.00	5.49	8.00	47.93	5.46	5.00

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1925—*Continued.*

Station No.	Manufacturer and Brand	Retail Dealer	Pounds per Hundred: Water	Ash	Protein N x 6.25: Found	Protein: Guaranteed, not less than	Fiber: Found	Fiber: Guaranteed, not more than	Nitrogen-free extract (starch, gum, etc.)	Fat: Found	Fat: Guaranteed, not less than
	PROPRIETARY MIXED FEEDS—*Continued.*										
	Poultry Feed—Continued.										
3164	*Larro Scratch Grains.* Larrowe Milling Co., Detroit, Mich. ...	*Bristol:* D. J. Minor	12.56	1.57	10.56	10.00	2.60	4.00	69.80	2.91	2.50
3002	*Nabob Scratch Feed.* Francis H. Leggett Co., Stamford, Conn..	*Stamford:* Francis H. Leggett Co.	11.30	1.67	10.50	9.00	3.15	4.00	70.04	3.34	3.00
3005	*Premier Growing Mash.* Francis H. Leggett Co., Stamford, Conn.	*Stamford:* Francis H. Leggett Co.	8.70	8.65	18.94	15.00	5.42	4.50	52.45	5.84	4.50
3337	*Premier Growing Mash.* Francis H. Leggett Co., Stamford, Conn.	*Stamford:* Francis H. Leggett Co. Co.	9.33	8.72	19.44	15.00	5.53	4.50	51.23	5.75	4.50
3006	*Premier Laying Mash.* Francis H. Leggett Co., Stamford. Conn.	*Stamford:* Francis H. Leggett Co.	8.50	11.43	23.38	20.00	5.10	8.50	46.11	5.48	4.00
3003	*Premier Scratch Feed.* Francis H. Leggett Co., Stamford, Conn.	*Stamford:* Francis H. Leggett Co.	10.46	1.64	10.88	9.00	3.13	4.00	70.93	2.96	3.00
3570	*Homestead Dry Mash.* The C. W. Lines Co., New Britain	*New Britain:* The C. W. Lines Co.	9.38	8.41	21.00	18.00	5.80	7.00	49.43	5.98	4.00
3569	*Homestead Scratch Feed.* The C. W. Lines Co., New Britain	*New Britain:* The C. W. Lines Co.	12.25	8.42	10.19	9.00	2.53	5.00	62.38	4.23	2.50

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1925—*Continued.*

Station No.	Manufacturer and Brand	Retail Dealer	Pounds per Hundred								
			Water	Ash	Protein N x 6.25		Fiber		Nitrogen-free extract (starch, gum, etc.)	Fat	
					Found	Guaranteed, not less than	Found	Guaranteed, not more than		Found	Guaranteed, not less than
	PROPRIETARY MIXED FEEDS—*Continued.*										
	Poultry Feed—Continued.										
2258	*Red Star Egg Mash.* E. Manchester & Sons, Winsted	*Winsted:* E. Manchester & Sons	8.30	11.02	19.56	18.00	6.43	8.00	48.11	6.58	4.00
3078	*Red Star Buttermilk Growing Mash.* E. Manchester & Sons, Winsted	*Winsted:* E. Manchester & Sons	7.72	6.16	16.44	20.00	3.90	6.00	59.63	6.15	4.00
3079	*Armour's Cak-Cak Laying Mash.* Mapl-Flake Mills, Inc., Chicago, Ill.	*New Milford:* Geo. E. Ackley Co.	7.53	7.78	21.88	20.00	5.90	6.00	50.14	6.77	3.00
3044	*Iroquois Poultry Mash.* Mapl-Flake Mills, Inc., Chicago, Ill.	*Danbury:* C. S. Barnum & Son.	9.44	5.89	16.88	15.00	6.58	6.00	55.77	5.44	4.00
3045	*Iroquois Scratching Grains.* Mapl-Flake Mills, Inc., Chicago, Ill.	*Danbury:* C. S. Barnum & Son.	12.25	1.48	10.13	10.00	2.98	5.00	70.32	2.84	3.00
2776	*Bull Brand Laying Mash with Dried Buttermilk.* Maritime Milling Co., Buffalo, N. Y. ...	*New Milford:* Geo. E. Ackley Co.	8.35	11.36	19.75	20.00	5.35	8.00	48.97	6.22	5.00
2775	*Red E Mixt Scratch Feed.* Maritime Milling Co., Buffalo, N. Y.	*New Milford:* Geo. E. Ackley Co.	10.80	1.47	10.31	10.00	2.48	4.00	71.85	3.09	2.50
3520	*Red Wing Scratch Feed.* Mech & Stoddard, Inc., Middletown	*Hamden:* Ira W. Beers	9.20	1.60	11.00	10.00	2.48	5.00	73.02	2.70	3.00

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1925—*Continued.*

Station No.	Manufacturer and Brand	Retail Dealer	Pounds per Hundred: Water	Ash	Protein N x 6.25: Found	Protein: Guaranteed, not less than	Fiber: Found	Fiber: Guaranteed, not more than	Nitrogen-free extract (starch, gum, etc.)	Fat: Found	Fat: Guaranteed, not less than
	PROPRIETARY MIXED FEEDS—*Continued.*										
	Poultry Feed—Continued.										
3580	*Red Wing Special Buttermilk Chick Starter.* Meech & Stoddard, Inc., Middletown	*Middletown:* Meech & Stoddard, Inc.	11.95	7.55	19.75	13.00	4.85	5.00	49.85	6.05	4.00
3528	*Red Wing Special Buttermilk Growing Feed.* Meech & Stoddard, Inc., Middletown	*East Hartford:* Meech Grain Co.	6.88	17.34	20.13	17.00	5.18	8.00	44.84	5.63	5.50
3571	*Red Wing Special Buttermilk Laying Mash.* Meech & Stoddard, Inc., Middletown	*East Hartford:* Meech Grain Co.	10.55	7.04	19.00	17.00	6.50	8.00	51.23	5.68	5.50
3577	*Red Wing Special Chick Feed.* Meech & Stoddard, Inc., Middletown, Conn.	*Middletown:* Meech & Stoddard, Inc.	12.15	1.53	10.44	10.00	1.75	5.00	70.65	3.48	3.00
2779	*Red Wing Special Dry Mash.* Meech & Stoddard, Inc., Middletown, Conn.	*East Hartford:* Meech Grain Co.	8.88	7.41	18.31	17.00	6.28	7.00	53.82	5.30	5.50
3578	*Red Wing Special Intermediate Chick Feed.* Meech & Stoddard Inc., Middletown	*Middletown:* Meech & Stoddard, Inc.	14.15	1.60	10.19	10.00	2.85	5.00	67.53	3.68	3.00
2250	*No. 1 Scratch Feed.* Miner-Hillard Milling Co., Wilkes-Barre, ...	*Torrington:* F. W. Wadhams ..	12.08	1.55	10.50	8.00	2.84	4.00	69.65	3.38	2.00

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1925—*Continued.*

Station No.	Manufacturer and Brand	Retail Dealer	Pounds per Hundred: Water	Ash	Protein N x 6.25: Found	Protein: Guaranteed, not less than	Fiber: Found	Fiber: Guaranteed, not more than	Nitrogen-free extract (starch, gum, etc.)	Fat: Found	Fat: Guaranteed, not less than
	PROPRIETARY MIXED FEEDS—*Continued.*										
	Poultry Feeds—Continued.										
3524	*Moon's Special A Scratch Feed.* Geo. O. Moon & Co., Binghamton, N. Y.	*Thomaston:* Cunningham & Wallace	9.90	1.59	10.31	10.00	3.33	5.00	71.82	3.05	2.00
3027	*C-B Mash.* Moran-Patton Co., New Haven, Conn.	*New Haven:* Moran-Patton Co.	9.10	7.83	20.88	18.00	6.65	7.00	50.09	5.45	4.00
2847	*Old Mill Buttermilk Laying Mash.* Fred C. Morse, Guilford, Conn.	*Guilford:* Fred C. Morse	9.58	7.43	20.50	18.00	5.90	8.00	50.84	5.75	4.00
2846	*Old Mill Mash Feed.* Fred C. Morse, Guilford, Conn.	*Guilford:* Fred C. Morse	9.41	8.31	21.31	18.00	6.05	8.00	48.97	5.95	4.00
2850	*Old Mill Scratch Feed.* Fred C. Morse, Guilford, Conn.	*Guilford:* Fred C. Morse	11.18	1.51	10.25	10.00	2.55	4.00	71.34	3.17	3.00
2875	*Genesee Scratching Grains.* Mystic Milling & Feed Co., Rochester, N. Y.	*Plainville:* W. S. Eaton	11.38	1.53	10.69	10.00	2.75	3.00	70.97	2.68	2.50
3170	*Domino Crate Fattener with Buttermilk.* Nowak Milling Corp., Hammond, Ind.	*Waterville:* Wooster Feed Store	8.33	2.61	15.75	14.00	5.13	7.00	61.55	6.63	4.50
3340	*Domino Developing Feed.* Nowak Milling Corp., Hammond, Ind.	*Manchester:* I. P. Campbell	10.78	1.52	10.25	10.00	2.12	5.00	72.20	3.13	3.00

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1925—*Continued.*

Station No.	Manufacturer and Brand	Retail Dealer	Water	Ash	Protein N x 6.25 Found	Protein Guaranteed, not less than	Fiber Found	Fiber Guaranteed, not more than	Nitrogen-free extract (starch, gum, etc.)	Fat Found	Fat Guaranteed, not less than
	PROPRIETARY MIXED FEEDS—*Continued.*										
	Poultry Feeds—Continued.										
3172	*Domino Laying Mash with Buttermilk.* Nowak Milling Corp., Hammond, Ind.	*Waterville:* Wooster Feed Store	9.79	7.77	19.31	18.00	4.58	7.00	53.55	5.00	3.50
3171	*Domino Pigeon Feed.* Nowak Milling Corp., Hammond, Ind.	*Waterville:* Wooster Feed Store	11.42	1.68	12.63	10.00	2.78	5.00	69.14	2.35	3.00
3168	*Domino Scratch Feed.* Nowak Milling Corp., Hammond, Ind.	*Waterville:* Wooster Feed Store	12.35	1.67	11.31	10.00	2.53	5.00	68.99	3.15	3.00
3029	*Fidelity Scratch Feed.* Nowak Milling Corp., Hammond, Ind.	*Higganum:* Felix A. Petrofsky	11.25	1.48	10.56	10.00	2.79	5.00	71.06	2.86	3.00
3180	*Marathon Chick Feed.* Nowak Milling Corp., Hammond, Ind.	*Waterville:* Wooster Feed Store	11.18	1.58	10.50	11.00	1.60	5.00	71.64	3.50	2.00
3124	*Marathon Laying Mash with Buttermilk.* Nowak Milling Corp., Hammond, Ind.	*Manchester:* I. P. Campbell	8.88	7.23	21.63	20.00	6.55	9.00	50.10	5.61	4.50
3176	*Marathon Scratch Feed.* Nowak Milling Corp., Hammond, Ind.	*Waterville:* Wooster Feed Store	12.45	1.53	10.06	10.00	2.83	5.00	67.94	5.19	3.00
2883	*Osborn Mash.* S. V. Osborn Estate, Branford, Conn.	*Branford:* S. V. Osborn Estate	9.53	3.21	15.75	12.00	6.33	8.00	61.25	3.93	3.00
2884	*Osborn Scratch.* S. V. Osborn Estate, Branford, Conn.	*Branford:* S. V. Osborn Estate	11.33	1.87	10.50	10.00	2.95	5.00	69.50	3.85	2.00

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1925—*Continued.*

Station No.	Manufacturer and Brand	Retail Dealer	Water	Ash	Protein N x 6.25		Fiber		Nitrogen-free extract (starch, gum, etc.)	Fat	
					Found	Guaranteed, not less than	Found	Guaranteed, not more than		Found	Guaranteed, not less than
	PROPRIETARY MIXED FEEDS—*Continued.*										
	Poultry Feeds—Continued.										
2275	*Baby Buster Chick Feed.* Park & Pollard Co., Buffalo, N. Y.	*Canaan:* Ives & Pierce	10.83	1.75	11.13	10.00	1.88	5.00	71.67	2.74	2.00
3572	*Bonnie Booster.* Park & Pollard Co., Buffalo, N. Y.	*East Hartford:* Meech Grain Co.	11.30	5.30	15.50	12.00	3.58	3.00	60.47	3.85	3.00
2273	*Growing Feed.* Park & Pollard Co., Buffalo, N. Y.	*Canaan:* Ives & Pierce	9.95	8.89	15.13	14.00	4.55	8.00	57.43	4.05	1.50
2274	*Intermediate Chick Feed.* Park & Pollard Co., Buffalo, N. Y.	*Canaan:* Ives & Pierce	11.23	1.51	10.25	10.00	2.43	5.00	71.48	3.10	1.50
2226	*Lay or Bust Dry Mash.* Park & Pollard Co., Buffalo, N. Y.	*Waterbury:* Spencer Grain Co.	9.90	9.16	18.75	18.00	6.10	12.00	51.34	4.75	1.50
2265	*Leghorn Special Dry Mash.* Park & Pollard Co., Buffalo, N. Y.	*Torrington:* F. W. Wadhams	*9.33*	*11.32*	*21.88*	*21.00*	5.80	*10.00*	*46.72*	4.95	1.50
2960	*Pigeon Feed.* Park & Pollard Co., Buffalo, N. Y.	*Westerly:* C. W. Campbell Co.	10.93	1.82	13.50	10.00	2.48	5.00	68.94	2.33	1.50
2222	*Red Ribbon Scratch Feed.* Park & Pollard Co., Buffalo, N. Y.	*Ansonia:* Ansonia Flour & Feed Co.	12.15	1.49	10.19	10.00	2.70	5.00	70.49	2.98	1.50
2215	*P-H Mash.* Peterson-Hendee Co., Derby, Conn.	*Derby:* Peterson-Hendee Co.	10.43	6.92	**15.63**	17.00	4.13	7.00	58.41	4.48	4.00
2216	*P-H Scratch Feed.* Peterson-Hendee Co., Derby, Conn.	*Derby:* Peterson-Hendee Co.	11.85	1.75	10.38	10.00	2.88	5.00	70.26	2.88	2.00

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1925—*Continued.*

Station No.	Manufacturer and Brand	Retail Dealer	Water	Ash	Protein N x 6.25 Found	Protein Guaranteed, not less than	Fiber Found	Fiber Guaranteed, not more than	Nitrogen-free extract (starch, gum, etc.)	Fat Found	Fat Guaranteed, not less than
	Pounds per Hundred										
	PROPRIETARY MIXED FEEDS—*Continued.*										
	Poultry Feeds—Continued.										
3085	*Platco Laying Mash.* Frank S. Platt Co., New Haven, Conn.	*New Haven:* Frank S. Platt Co.	6.88	13.60	21.81	20.00	6.06	7.00	44.42	7.23	5.50
3025	*Platco Perfection Grain Mixture.* Frank S. Platt Co., New Haven, Conn.	*New Haven:* Frank S. Platt Co.	11.91	1.59	10.75	10.50	2.70	4.50	69.80	3.25	3.50
3026	*Platt's Pigeon Mixture.* Frank S. Platt Co., New Haven, Conn.	*New Haven:* Frank S. Platt Co.	11.48	1.84	13.00	13.00	3.65	5.00	65.25	4.78	4.50
3039	*Pratt's Supreme Pigeon Feed with Corn.,* Pratt's Food Co., Philadelphia, Penn.	*New Britain:* S. P. Strople	11.07	1.64	13.56	10.00	2.48	5.00	68.57	2.68	2.50
3037	*Pratt's Victory Laying Mash.* Pratt Food Co., Philadelphia, Penn.	*New Britain:* S. P. Strople	8.89	6.94	18.44	18.00	6.68	9.00	53.57	5.48	4.00
3040	*Pratt's Victory Large Scratch Feed.* Pratt's Food Co., Philadelphia, Penn.	*New Britain:* S. P. Strople	10.85	1.44	10.38	10.00	2.33	5.00	72.25	2.75	2.50
2793	*Egg-Em-On Laying Mash.* H. C. Puffer, Springfield, Mass.	*Suffield:* Spencer Bros.	9.33	8.80	21.50	20.00	6.50	9.00	49.13	4.74	4.00
2792	*Egg-Em-On Scratch Grains.* H. C. Puffer, Springfield, Mass.	*Suffield:* Spencer Bros.	11.63	1.40	9.63	10.00	2.34	5.00	72.02	2.98	1.50

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1925 *Continued.*

Station No.	Manufacturer and Brand	Retail Dealer	Water	Ash	Protein N x 6.25 Found	Protein Guaranteed, not less than	Fiber Found	Fiber Guaranteed, not more than	Nitrogen-free extract (starch, gum, etc.)	Fat Found	Fat Guaranteed, not less than
	PROPRIETARY MIXED FEEDS—*Continued.*										
	Poultry Feeds—Continued.										
2893	*Ful-O-Pep Egg Mash.* Quaker Oats Co., Chicago, Ill.	*Hamden:* Ira W. Beers	7.73	12.08	20.81	20.00	6.95	8.00	46.85	5.58	4.00
2876	*Schumacher's Scratch Grains, No Grit.* Quaker Oats Co., Chicago, Ill.	*Thompsonville:* Geo. S. Phelps & Co.	11.40	1.65	10.94	10.00	2.90	3.50	70.13	2.98	2.00
3088	*Purina Baby Chick Chow Feed.* Ralston Purina Mills, St. Louis, Mo.	*New Haven:* Moran-Patton Co.	10.80	1.57	11.06	10.00	1.90	4.00	72.38	2.29	2.00
2874	*Purina Chicken Chowder Feed.* Ralston Purina Mills, St. Louis, Mo.	*Torrington:* F. W. Wadhams	8.68	7.77	19.94	19.00	6.97	7.00	51.84	4.80	4.00
3093	*Purina Chicken Fat Chow Feed.* Ralston Purina Mills, St. Louis, Mo.	*Middletown:* H. G. Wadhams	8.44	4.80	16.00	15.50	3.73	4.50	62.14	4.89	4.60
3087	*Purina Chicken Fatena Feed.* Ralston Purina Mills, St. Louis, Mo.	*New Haven:* Moran-Patton Co.	8.30	3.47	14.69	12.00	5.93	6.60	62.56	5.05	4.60
2888	*Purina Chick Startena Feed.* Ralston Purina Mills, St. Louis, Mo.	*Derby:* Peterson-Hendee Co.	8.53	7.00	19.44	17.00	6.15	7.50	52.47	6.41	4.00

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1925—*Continued.*

Station No.	Manufacturer and Brand	Retail Dealer	Pounds per Hundred: Water	Ash	Protein N x 6.25: Found	Protein: Guaranteed, not less than	Fiber: Found	Fiber: Guaranteed, not more than	Nitrogen-free extract (starch, gum, etc.)	Fat: Found	Fat: Guaranteed, not less than
	PROPRIETARY MIXED FEEDS—*Continued.*										
	Poultry Feeds—Continued.										
2878	*Purina Hen Chow Feed.* Ralston Purina Mills, St. Louis, Mo...	*Rockville:* Rockville Grain & Coal Co.	12.10	1.52	10.50	10.00	2.75	4.00	69.91	3.22	2.50
3326	*Purina Intermediate Hen Chow Feed.* Ralston Purina Mills, St. Louis, Mo.	*New Haven:* Moran-Patton Co..	11.64	1.30	10.13	10.00	2.09	4.00	71.87	2.97	2.50
3001	*Purina Pigeon Chow Feed.* Ralston Purina Mills, St. Louis, Mo.	*Stamford:* W. L. Crabb	11.83	2.05	14.75	12.00	2.85	4.00	66.06	2.46	2.00
3143	*Winner Scratch Feed.* Ralston Purina Co., St Louis, Mo.	*Middletown:* H. G. Wadhams ..	11.43	1.42	10.38	10.00	2.38	5.00	71.64	2.75	2.00
2794	*Diamond Scratch Feed.* Rockville Grain & Coal Co., Rockville, Conn.	*Rockville:* Rockville Grain & Coal Co.	11.85	1.51	10.69	10.00	2.64	4.00	70.66	2.65	3.00
2907	*Advance Egg Mash.* Rosenbaum Bros., Chicago, Ill.	*Stafford Springs:* Dennis Grain Mill	8.58	11.13	18.75	18.00	5.90	8.00	48.36	7.28	4.00
2905	*77 Scratch Feed, No Grit.* Rosenbaum Bros., Chicago, Ill.	*Stafford Springs:* Dennis Grain Mill	11.23	1.72	10.69	10.00	2.98	5.00	70.03	3.35	2.00
3567	*Vitality Chick Starter.* Rosenbaum Bros., Chicago, Ill.	*New Britain:* S. P. Strople	10.70	6.21	17.06	15.00	4.65	6.00	56.65	4.73	5.00

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1925—*Continued.*

Station No.	Manufacturer and Brand	Retail Dealer	Pounds per Hundred								
			Water	Ash	Protein N x 6.25		Fiber		Nitrogen-free extract (starch, gum, etc.)	Fat	
					Found	Guaranteed, not less than	Found	Guaranteed, not more than		Found	Guaranteed, not less than
	PROPRIETARY MIXED FEEDS—*Continued.*										
	Poultry Feeds—Continued.										
2231	*Vitality Egg Mash without Buttermilk.* Rosenbaum Bros., Chicago, Ill.	*Hamden:* Ira W. Beers	9.28	12.13	22.69	20.00	7.05	10.00	41.54	7.31	3.00
2906	*Vitality Egg Mash with Buttermilk.* Rosenbaum Bros., Chicago, Ill.	*Stafford Springs:* Dennis Grain Mill	9.03	9.75	20.63	20.00	5.58	8.00	48.66	6.35	4.00
3565	*Vitality Fine Chick Scratch.* Rosenbaum Bros., Chicago, Ill.	*New Britain:* S. P. Strople	12.28	6.12	11.31	10.00	1.28	3.00	63.13	5.88	3.50
2909	*Vitality Growing Mash.* Rosenbaum Bros., Chicago, Ill.	*Stafford Springs:* Dennis Grain Mill	9.28	5.72	16.44	15.00	5.53	6.00	57.28	5.75	5.00
2230	*Vitality Scratch, No Grit.* Rosenbaum Bros., Chicago, Ill.	*Hamden:* Ira W. Beers	12.28	1.57	10.38	10.00	2.60	5.00	70.19	2.98	2.50
2923	*Homespun Laying Mash.* Paty Schwartz Co., New London, Conn.	*New London:* Paty Schwartz Co.	8.46	6.30	15.00	20.00	8.50	10.00	55.90	5.75	4.00
3064	*Homespun Scratch Grains.* Paty Schwartz Co., New London, Conn.	*New London:* Paty Schwartz Co.	11.30	1.50	10.00	10.00	2.88	5.00	71.26	3.06	1.50
2891	*"See-More Egg" Buttermilk Mash.* Seymour Grain & Coal Co., Seymour, Conn.	*Seymour:* Seymour Grain & Coal Co.	9.32	9.55	21.69	18.00	4.40	8.00	49.54	5.50	4.50

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1925—*Continued.*

Station No.	Manufacturer and Brand	Retail Dealer	Water	Ash	Protein N x 6.25: Found	Protein: Guaranteed, not less than	Fiber: Found	Fiber: Guaranteed, not more than	Nitrogen-free extract (starch, gum, etc.)	Fat: Found	Fat: Guaranteed, not less than
	PROPRIETARY MIXED FEEDS—*Continued.*										
	Poultry Feeds—Continued.										
2892	*"See-More Egg" Scratch Feed.* Seymour Grain & Coal Co., Seymour, Conn.	*Seymour:* Seymour Grain & Coal Co.	10.94	1.44	9.81	10.00	2.98	6.00	71.88	2.95	3.00
2220	*Nelson Mixed Chicken Feed.* Shelton Feed Co., Shelton, Conn.	*Shelton:* Shelton Feed Co.	11.83	2.65	10.31	10.00	2.83	5.00	69.64	2.74	1.50
2219	*Nelson Laying Mash.* Shelton Feed Co., Shelton, Conn.	*Shelton:* Shelton Feed Co.	9.93	8.78	18.06	16.00	5.43	8.00	52.65	5.15	4.00
2805	*"Mill Streams" Fortune Hunter Scratch Grains.* Winchell Smith Inc., Farmington, Conn.	*Farmington:* Winchell Smith, Inc.	11.88	1.59	10.50	10.00	3.18	3.00	69.45	3.40	2.50
2789	*"Mill Streams" Lightnin Laying Mash.* Winchell Smith, Inc., Farmington, Conn.	*Farmington:* Winchell Smith, Inc.	9.30	10.19	20.38	16.00	5.78	7.00	49.10	5.25	3.00
2238	*Wirthmore Buttermilk Mash Feed with Fish and Meat Scraps.* St. Albans Grain Co., St. Albans, Vt.	*Hamden:* Ira W. Beers	9.52	8.82	20.81	20.00	5.49	7.00	49.77	5.59	4.00

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1925—*Continued.*

Station No.	Manufacturer and Brand	Retail Dealer	Pounds per Hundred: Water	Ash	Protein N x 6.25: Found	Protein: Guaranteed, not less than	Fiber: Found	Fiber: Guaranteed, not more than	Nitrogen-free extract (starch, gum, etc.)	Fat: Found	Fat: Guaranteed, not less than
	PROPRIETARY MIXED FEEDS—*Continued.*										
	Poultry Feeds—Continued.										
2802	*Wirthmore Growing Feed with Dried Buttermilk and Beef Scraps.* St. Albans Grain Co., St. Albans, Vt.	*New Milford:* Geo. T. Soule	9.53	8.44	17.06	15.00	5.25	4.50	54.07	5.65	4.50
2235	*Wirthmore Intermediate Chick Feed.* St. Albans Grain Co., St. Albans, Vt.	*Seymour:* Seymour Grain & Coal Co.	10.78	1.36	10.44	10.00	2.39	3.50	72.49	2.54	3.00
2239	*Wirthmore Scratch Feed.* St. Albans Grain Co., St. Albans, Vt.	*West Cheshire:* G. W. Thorpe	11.78	1.54	10.69	10.00	2.97	5.00	70.29	2.73	3.00
2284	*Onondaga Scratch Grains.* Syracuse Milling Co., Syracuse, N. Y.	*Norfolk:* Aug. P. Curtis	12.90	1.57	10.44	10.00	2.50	5.00	69.84	2.75	3.00
2998	*Syragold Chick Feed.* Syracuse Milling Co., Syracuse, N. Y.	*Southport:* C. Buckingham & Co.	11.30	1.77	11.25	10.00	1.33	5.00	70.35	4.00	2.50
2999	*Syragold Chick Starter.* Syracuse Milling Co., Syracuse, N. Y.	*Southport:* C. Buckingham & Co.	10.00	6.57	16.81	18.00	2.01	4.00	60.26	4.35	3.50
3334	*Syragold Chick Starter.* Syracuse Milling Co., Syracuse, N. Y.	*Southport:* C. Buckingham & Co.	10.75	7.15	17.00	18.00	1.83	4.00	59.64	3.63	3.50

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1925—*Continued.*

Station No.	Manufacturer and Brand	Retail Dealer	Water	Ash	Protein N x 6.25 Found	Protein Guaranteed, not less than	Fiber Found	Fiber Guaranteed, not more than	Nitrogen-free extract (starch, gum, etc.)	Fat Found	Fat Guaranteed, not less than
	PROPRIETARY MIXED FEEDS—*Continued.*										
	Poultry Feeds—Continued.										
2280	*Syragold Egg Mash.* Syracuse Milling Co., Syracuse, N. Y. ...	*Torrington:* F. U. Wadhams ...	9.09	7.54	20.31	18.00	5.90	8.00	51.32	5.84	3.00
2281	*Syragold Growing Mash.* Syracuse Milling Co., Syracuse, N. Y.	*Torrington:* F. U. Wadhams ...	9.83	4.79	16.56	16.00	3.44	7.00	60.64	4.74	4.00
2271	*Syragold Scratch Grains.* Syracuse Milling Co., Syracuse, N. Y.	*Torrington:* F. L. Wadhams ...	11.20	1.38	10.63	10.00	2.63	5.00	71.36	2.80	3.00
2978	*Derby Scratch Feed.* Tioga Mill & Elevator Co., Waverly, N. Y.	*Hawleyville:* W. A. Honan	11.48	1.57	9.88	9.00	3.55	4.50	70.72	2.80	2.04
2804	*Egatine.* Tioga Mill & Elevator Co., Waverly, N. Y.	*North Haven:* Wm. L. Thorpe..	8.88	9.06	25.81	23.00	4.47	6.00	47.31	4.47	2.50
2928	*Tioga Laying Food.* Tioga Mill & Elevator Co., Waverly, N. Y.	*Hawleyville:* W. A. Honan	9.53	7.44	20.31	17.00	4.98	6.00	51.86	5.88	2.50
2283	*Rex Scratch Feed.* United Flour & Feed Co., Inc., Albany, N. Y.	*Winsted:* Chas. R. Hawley	11.70	1.51	10.13	10.00	2.40	5.00	71.36	2.90	3.00
2282	*United Laying Mash* (Storrs Formula). United Flour & Feed Co., Inc., Albany, N. Y..	*Winsted:* Chas. R. Hawley	9.57	8.75	20.50	20.00	5.32	7.00	50.41	5.45	4.00

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1925—*Continued.*

Station No.	Manufacturer and Brand	Retail Dealer	Pounds per Hundred: Water	Ash	Protein N x 6.25: Found	Protein: Guaranteed, not less than	Fiber: Found	Fiber: Guaranteed, not more than	Nitrogen-free extract (starch, gum, etc.)	Fat: Found	Fat: Guaranteed, not less than
	PROPRIETARY MIXED FEEDS—*Continued.*										
	Poultry Feeds—Continued.										
2808	*United Scratch Feed.* United Flour & Feed Co., Albany, N. Y.	*Thompsonville:* Geo. S. Phelps & Co.	11.40	1.46	10.31	10.00	2.75	4.00	70.95	3.13	3.00
2284	*Waldorf Milk Grains.* United Flour & Feed Co., Albany, N. Y.	*Winsted:* Chas. R. Hawley	9.72	4.79	21.88	20.00	7.83	10.00	51.13	4.65	3.50
2801	*Eventually Gold Medal Vitamin Egg Mash.* Washburn-Crosby Co., Minneapolis, Minn.	*New Milford:* W. L. Richmond & Son	8.23	7.66	21.19	20.00	6.95	8.50	50.56	5.41	5.50
2974	*Big Y Growing Feed.* Yantic Grain & Products Co., Norwich, Conn.	*Norwich:* Yantic Grain & Products Co.	8.15	7.45	20.13	17.00	6.76	6.00	51.11	6.40	4.00
2913	*Big Y Laying Mash.* Yantic Grain & Products Co., Norwich, Conn.	*Willimantic:* Boston Grain Co.	8.63	8.28	21.81	20.00	6.64	7.00	48.51	6.13	4.00
2971	*Uncas Scratch Feed.* Yantic Grain & Products Co., Norwich, Conn.	*Norwich:* Yantic Grain & Products Co.	11.00	1.62	10.19	11.00	3.03	5.00	70.83	3.33	3.00

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1925—*Continued.*

Station No.	Manufacturer and Brand	Retail Dealer	Water	Ash	Protein N x 6.25: Found	Protein N x 6.25: Guaranteed, not less than	Fiber: Found	Fiber: Guaranteed, not more than	Nitrogen-free extract (*starch, gum, etc.*)	Fat: Found	Fat: Guaranteed, not less than
			Pounds per Hundred								
	PROPRIETARY MIXED FEEDS—*Continued.*										
	Poultry Feeds—Continued.										
	Beef Scrap, etc.										
2831	*Beach Star Brand Beef Scrap.* Beach Soap Co., Lawrence, Mass.	*Mystic:* J. L. Manning & Co.	5.55	3.73	38.00	35.00	1.59	2.50	37.74	13.39	10.00
2209	*Collis Process Pure Dried Buttermilk.* Collis Products Co., Clinton, Iowa	*Hamden:* Ira W. Beers	10.45	10.56	30.50	30.00	....	....	41.79	6.70	5.00
3190	*Cooked Meat Scrap.* Conn. Fat Rendering & Fertilizer Corp., New Haven, Conn.	*Guilford:* F. H. Rolf	6.38	21.82	57.81	50.00	....	....	1.96	12.03	10.00
2204	*Meat Scrap for Poultry.* Conn. Fat Rendering & Fertilizer Corp., New Haven, Conn.	*Waterbury:* Spencer Grain Co.	5.60	30.52	50.31	40.00	....	....	2.19	11.38	10.00
3117	*Red W. Brand Meat Scraps.* Eastern States Farmers' Exchange, Springfield, Mass.	*New Canaan:* Clapboard Hill Farms	4.71	28.80	55.25	55.00	1.78	3.00	1.86	7.60	6.00
3154	*Fairmont's Better Pure Flake Buttermilk.* Fairmont Creamery Co., Omaha, Neb.	*Plantsville:* C. A. Cowles	8.53	9.74	35.13	32.00	....	....	40.45	6.15	6.00

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1925—*Continued.*

Station No.	Manufacturer and Brand	Retail Dealer	Pounds per Hundred: Water	Ash	Protein N x 6.25: Found	Protein: Guaranteed, not less than	Fiber: Found	Fiber: Guaranteed, not more than	Nitrogen-free extract (starch, gum, etc.)	Fat: *Found*	Fat: Guaranteed, not less than
	PROPRIETARY MIXED FEEDS—*Continued.*										
	Poultry Feeds—Continued.										
	Beef Scrap, etc.—Continued.										
2948	*Frisbie's Bone Meal 20-25% Protein* (For Cattle & Poultry). L. T. Frisbie Co., New Haven, Conn.	*New Haven:* L. T. Frisbie Co...	4.00	64.31	26.31	20.00	....	....	1.83	**2.65**	5.00
2256	*Frisbie's Bone and Meat Meal 35-45% Protein.* L. T. Frisbie Co., New Haven, Conn.	*Winsted:* Chas. R. Hawley	3.40	45.95	**29.94**	35.00	....	....	6.07	14.64	8.00
3142	*Frisbie's Bone and Meat Meal 35-45% Protein.* L. T. Frisbie Co., New Haven, Conn.	*New Haven:* L. T. Frisbie Co...	3.25	42.96	**33.56**	35.00	....	....	6.67	13.56	8.00
3329	*Frisbie's Bone and Meat Meal 35-45% Protein.* L. T. Frisbie Co., New Haven, Conn.	*New Haven:* L. T. Frisbie Co...	5.13	35.17	38.69	35.00	....	....	8.96	12.05	8.00
2246	*Frisbie's Poultry Feed 45-55% Protein.* L. T. Frisbie Co., New Haven, Conn.	*Torrington:* D. L. Talcott......	4.78	37.80	**39.06**	45.00	....	....	7.43	10.93	8.00
3137	*Frisbie's Pultry Feed 45-55% Protein.* L. T. Frisbie Co., New Haven, Conn.	*Hawleyville:* W. A. Honan	4.55	36.41	**40.63**	45.00	....	....	7.53	10.88	8.00

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1925—*Continued*.

Station No.	Manufacturer and Brand	Retail Dealer	Pounds per Hundred: Water	Ash	Protein N x 6.25: Found	Protein: Guaranteed, not less than	Fiber: Found	Fiber: Guaranteed, not more than	Nitrogen-free extract (starch, gum, etc.)	Fat: Found	Fat: Guaranteed, not less than
	PROPRIETARY MIXED FEEDS—*Continued.*										
	Poultry Feeds—Continued.										
	Beef Scrap, etc.—Continued.										
3327	*Frisbie's Poultry Feed 45-55% Protein.* L. T. Frisbie Co., New Haven, Conn.	*New Haven:* L. T. Frisbie Co...	5.10	27.78	49.44	45.00	....	....	3.90	13.78	8.00
2243	*Frisbie's Poultry Feed 55-65% Protein.* L. T. Frisbie Co., New Haven, Conn.	*Litchfield:* Wadhams Co.	8.20	24.61	53.94	55.00	....	....	1.57	11.68	8.00
3141	*Frisbie's Poultry Feed 55-65% Protein.* L. T. Frisbie Co., New Haven, Conn.	*New Haven:* L. T. Frisbie Co...	4.75	25.58	53.56	55.00	....	....	3.71	12.40	8.00
3328	*Frisbie's Poultry Feed 55-65% Protein.* L. T. Frisbie Co., New Haven, Conn.	*New Haven:* L. T. Frisbie Co...	6.55	21.36	56.88	55.00	....	....	3.76	11.45	8.00
2932	*Prisbie's Cracked Bone.* L. T. Frisbie Co., New Haven, Conn.	*New Haven:* L. T. Frisbie Co...	3.83	63.21	24.25	20.00	....	....	3.61	5.10	5.00
3196	*H. J. Selected Meat Scrap.* Henry James & Son, Worcester, Mass.	*Abington:* O. A. Weeks	6.23	31.58	46.88	42.00	1.18	6.00	2.95	11.18	10.00

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1925—*Continued.*

Station No.	Manufacturer and Brand	Retail Dealer	Pounds per Hundred: Water	Ash	Protein N x 6.25: Found	Protein: Guaranteed, not less than	Fiber: Found	Fiber: Guaranteed, not more than	Nitrogen-free extract (starch, gum, etc.)	Fat: Found	Fat: Guaranteed, not less than
	PROPRIETARY MIXED FEEDS—*Continued.*										
	Poultry Feeds—Continued.										
	Beef Scrap, etc.—Continued.										
2851	*Cooked Meat and Bone Scrap.* A. G. Markham, Springfield, Mass.	*Merrow:* I. F. Wilcox	7.17	29.86	50.31	45.00	....	....	2.78	9.88	8.00
3185	*Marsh's Pure Ground Scraps for Poultry.* Geo. E. Marsh Co., Lynn, Mass.	*Mystic:* Mystic Grain Co.	6.35	33.27	41.00	40.00	....	....	7.53	11.85	8.00
3076	*Blue Seal Meat Scraps.* New England By-Products Co., Lawrence, Mass.	*Plantsville:* C. A. Cowles	5.88	30.03	50.56	50.00	1.45	3.00	1.81	10.27	5.00
3074	*White Seal Meat Scraps.* New England By-Products Co., Lawrence, Mass.	*Derby:* Peterson-Hendee Co.	5.27	44.93	36.75	40.00	1.34	4.00	4.07	7.64	5.00
3521	*Norton's Meat and Bone Poultry Food.* Norton Tallow Co., Somerville, Mass.	*Watertown:* Watertown Coöp. Assoc.	4.15	35.80	40.63	45.00	....	....	5.92	13.50	8.00
3163[1]	*Rauh's Meato.* E. Rauh & Sons, Indianapolis, Ind.	*Plantsville:* C. A. Cowles	1.53	7.14	80.50	75.00	....	....	....	10.83	10.00
3533	*Reardon's Beef Scrap.* John Reardon & Sons Co., Cambridge, Mass.	*Westerly:* C. W. Campbell Co.	5.05	28.27	55.50	55.00	....	....	2.83	8.35	6.00

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1925—*Continued.*

Station No.	Manufacturer and Brand	Retail Dealer	Water	Ash	Protein N x 6.25: Found	Protein N x 6.25: Guaranteed, not less than	Fiber: Found	Fiber: Guaranteed, not more than	*Nitrogen-free extract* (starch, gum, etc.)	Fat: Found	Fat: Guaranteed, not less than
	PROPRIETARY MIXED FEEDS—*Concluded.*										
	Poultry Feeds—Concluded.										
	Beef Scrap, etc.—Concluded.										
3534	*Reardon's Beef Scrap.* John Reardon & Sons Co., Cambridge, Mass.	*Westerly:* C. W. Campbell Co.	4.65	39.07	44.81	45.00	....	....	3.39	8.08	6.00
2785	*Chic-Chuck.* Russia Cement Co., Gloucester, Mass.	*Plantsville:* C. A. Cowles	6.10	33.33	55.50	45.00	0.69	1.00	3.25	1.13	0.10
2807	*Springfield Ground Meat Scraps.* Springfield Rendering Co., Springfield, Mass.	*Suffield:* Spencer Bros.	6.51	36.35	45.31	45.00	....	....	2.03	9.80	7.00
2798	*Stanley's 45% to 50% Protein Meat Scrap.* John T. Stanley Co., Inc., New York City	*Derby:* Peterson-Hendee Co.	5.24	35.58	43.81	45.00	1.45	3.00	2.68	11.24	10.00
3127	*Stanley's 45% to 50% Protein Meat Scrap.* John T. Stanley Co., Inc., New York City	*Middletown:* Meech & Stoddard, Inc.	6.83	29.51	46.31	45.00	2.28	3.00	4.54	10.53	10.00
2899	*Vico Meat Scrap.* Van Iderstine Co., Long Island City, N. Y.	*New Milford:* Geo. T. Soule	7.63	21.26	57.50	55.00	1.90	3.00	0.46	11.25	5.00
2922	*P. W. Bone Meal.* Worcester Rendering Co., Auburn, Mass.	*New London:* Paty Schwartz Co.	3.58	59.51	20.38	20.00	....	....	4.30	12.23	5.00
2955	*P. W. Meat Scrap.* Worcester Rendering Co., Auburn, Mass.	*Mansfield Depot:* Martin M. Hansen	6.58	29.20	51.75	45.00	1.54	6.00	1.28	9.65	8.00
2956	*P. W. Special Meat Scrap.* Worcester Rendering Co., Auburn, Mass.	*Merrow:* I. F. Wilcox	6.25	25.04	55.13	55.00	1.43	5.00	0.57	11.58	8.00

Miscellaneous.

In Table II are given analyses of samples submitted by individuals or taken by the Station agent upon request. Here are included also various materials which have been examined for poisonous or injurious substances. Such comments as are required are noted in the tabulated statement.

TABLE II. ANALYSES OF FEEDING STUFFS SUBMITTED BY INDIVIDUALS.

Station No.	Material	Submitted by	Pounds per Hundred: Water	Ash	Protein (N x 6.25)	Fiber	Nitrogen-free extract (starch, gum, etc.)	Ether extract (crude fat)	Remarks
	COTTONSEED PRODUCTS.								
1827	Danish. Cottonseed Feed	*Middletown:* The Coles Co.	....	....	35.94	....	....	....	
2566	Danish. Cottonseed Meal	The Coles Co.	....	....	39.50	....	....	....	
	RYE PRODUCTS.								
2575	Rye Middlings No. 1	*Waterbury:* Scoville Mfg. Co.	11.35	4.38	15.19	5.79	60.22	3.07	
2576	Rye Middlings No. 2	Scoville Mfg. Co.	12.12	3.75	15.63	3.71	61.68	3.11	
	PROPRIETARY MIXED FEEDS.								
	Dairy Rations, etc.								
2901	Eshelman's Red Rose Dairy Feed	*Rockville:* E. E. Tucker	7.53	6.57	24.00	10.43	45.87	5.60	Guaranty: 24-10-4.
1197	Red Wing Junior Dairy Ration.	*Newington:* Thomas Holt	....	5.87	19.44	8.15	...	....	Contains 1.05% Salt (NaCl).
1198	Red Wing Junior Dairy Ration.	Thomas Holt	....	4.47	20.63	9.48	....	....	Contains trace of chlorine.
2832	Red Brand Dairy Feed	*New Britain:* Stanley-Svea Grain & Coal Co.	7.58	6.57	25.63	8.61	45.23	6.38	Guaranty: 24-10-4.5.
1230	Dairy Ration	*Amston:* R. F. Porter	....	....	22.81	10.53	....	5.45	
2984	Dairy Feed	*Middletown:* Sidney Edwards	8.01	5.18	20.75	8.05	54.11	3.90	
1541	Dairy Ration	*Guilford:* Fred C. Morse	10.60	6.75	21.56	8.71	47.36	5.02	
2669	Old Mill Dairy Ration	Fred C. Morse	11.68	....	23.00	8.78	....	5.23	
1564	Dairy Ration No. 1	*Middletown:* Meech & Stoddard, Inc.	6.74	....	25.56	8.02	....	6.39	

TABLE II. ANALYSES OF FEEDING STUFFS SUBMITTED BY INDIVIDUALS—*Continued.*

Station No.	Material	Submitted by	Pounds per Hundred: Water	Ash	Protein (N x 6.25)	Fiber	Nitrogen-free extract (starch, gum, etc.)	Ether extract (crude fat)	Remarks
	PROPRIETARY MIXED FEEDS—*Continued.*								
	Dairy Rations, etc.—Concluded.								
1665	Dairy Ration No. 2	Meech & Stoddard, Inc.	7.25	....	20.56	7.89	....	6.46	
2814	Basic Dairy Ration	*New Haven:* R. G. Davis & Sons	8.10	5.25	23.50	7.35	51.32	4.48	Guaranty: 20-9-5.
3548	Dairy Ration	*Gaylordsville:* W. D. Conn	7.13	1.45	25.13	10.25	50.19	5.85	
	Horse Feed.								
2663	Horse Feed	*Bridgeport:* Bridgeport Ice Delivery Co.	15.23	....	8.63	19.83	....	0.38	
2670	Old Mill Provender	*Guilford:* Fred C. Morse	13.38	....	9.75	5.00	....	3.80	
	Stock Feed.								
2599	Grain, Sample No. 1	*Somers:* C. S. Beaumont	11.47	4.94	26.06	10.51	42.42	4.60	
2600	Grain, Sample No. 2	C. S. Beaumont	11.85	6.31	24.00	19.09	35.60	3.15	
	Poultry Feeds.								
1115	Meat Scrap No. 1	*New Haven:* Conn. Fat Rendering Co.	6.78	....	56.19	2.38	....	11.43	
1116	Meat Scrap No. 2	Conn. Fat Rendering Co.	4.90	....	52.06	1.78	....	11.13	
1117	Meat Scrap No. 3	Conn. Fat Rendering Co.	6.35	....	62.00	3.73	....	12.35	
2902	Bone Meal for Poultry	*Winsted:* A. J. Beckman	....	64.55	24.88	....	....	....	
2903	Bone Meal for Poultry	A. J. Beckman	....	86.00	5.13	....	....	....	

TABLE II. ANALYSES OF FEEDING STUFFS SUBMITTED BY INDIVIDUALS—*Continued*.

Station No.	Material	Submitted by	Water	Ash	Protein (N x 6.25)	Fiber	Nitrogen-free extract (starch, gum, etc.)	Ether extract (crude fat)	Remarks
			Pounds per Hundred						
	PROPRIETARY MIXED FEEDS—*Concluded.*								
	Poultry Feeds—Concluded.								
3055	Edible Steamed Bone Meal	*Norwich:* Yantic Grain & Products Co.	....	....	13.81	....	....	....	Contains 14.68% Phosphoric Acid (P_2O_5).
1762	Beef Scrap No. 1	*Middletown:* Sidney A. Edwards	....	....	39.50	....	....	....	Contains 12.23% Phosphoric Acid (P_2O_5).
1763	Beef Scrap No. 2	Sidney A. Edwards	....	....	45.31	....	....	....	
3304	Beef Scrap	*Gilead:* Joseph A. Barrasso	6.28	26.85	53.88	....	....	9.39	
2597	Ingersoll Special Egg Mash	*Stratford:* Z. C. Ingersoll	11.51	10.31	18.31	8.44	44.98	6.45	
3158	Scratch Feed	*New Britain:* C. W. Lines Co.	10.54	1.39	10.00	2.20	72.88	2.90	
2667	Scratch Feed	*Guilford:* Fred C. Morse	14.00	....	10.56	3.88	....	2.73	
2668	Old Mill Mash Feed	Fred C. Morse	11.90	....	22.25	6.73	....	5.80	
2598	Poultry Mash	*Rockville:* Rockville Grain & Coal Co.	9.82	17.58	23.06	8.68	36.01	4.85	Ash contains charcoal.
2664	Poultry Mash No. 1	*Guilford:* Fred H. Rolf	10.13	....	16.88	4.40	....	4.95	
2665	Poultry Mash No. 2	Fred H. Rolf	10.48	....	21.75	5.00	....	4.03	
2666	Poultry Mash No. 3	Fred H. Rolf	11.05	....	16.25	5.15	....	3.10	
2740	Purina Hen Chowder	*Little River:* Walnut Crest Poultry Farm	8.65	....	21.25	8.26	....	4.68	

TABLE II. ANALYSES OF FEEDING STUFFS SUBMITTED BY INDIVIDUALS—*Continued.*

Station No.	Material	Submitted by	Pounds per Hundred: Water	Ash	Protein (*N x 6.25*)	Fiber	Nitrogen-free extract (starch, gum, etc.)	Ether extract (crude fat)	Remarks
	MISCELLANEOUS.								
2194	Alfalfa Leaf Meal, Sample A	*Unionville:* F. D. Lawton & Son	....	....	21.44	15.88	....	....	
2195	Alfalfa Leaf Meal, Sample B	F. D. Lawton & Son	....	....	24.38	13.07	....	....	
1202	Beet Pulp	*Bridgeport:* Mitchell Dairy Co.	74.88	1.19	4.29	3.55	15.97	0.12	Soaked in skim milk.
1352	Dried Buttermilk	*Guilford:* Fred H. Rolf	7.51	8.77	34.32	....	42.15	7.25	Protein N x 6.38.
3072	Feed	*Torrington:* Ralph H. Alcott	....	....	24.69	....	....	....	
1201	Ground Screenings	*Southport:* Daniel H. Morgan	8.65	5.03	14.50	11.85	50.32	9.65	
2596	Hemp Seed	*New Haven:* Frank S. Platt Co.	10.00	5.46	21.75	8.34	24.83	29.62	
1203	Mixed Feed	*Hartford:* H. O. Daniels	8.63	5.30	22.13	9.50	40.41	5.03	
1424	Corn, Flint	Dept. of Plant Breeding	7.60	....	....	....	....	....	
1425	Corn, *Dent*	*Dept. of Plant Breeding*	6.95	....	....	....	....	....	
1483	Corn, shelled corn	Dept. of Plant Breeding	5.50	2.58	13.88	3.09	35.36	10.68	
3359	Corn, Dent	Dept. of Plant Breeding	5.75	....	....	....	....	....	
3360	Corn, Flint	Dept. of Plant Breeding	6.65	....	....	....	....	....	
3419	Red Wheat	*Willimantic:* Reuben Fishbein	....	....	....	....	....	....	Wheat 87%; Oats 9.80%; Barley 2.70%; Weed 0.50%; Corn, trace.
2697	Mash	*Long Ridge:* Louis Draghi	....	....	....	....	....	....	Consisted chiefly of corn, oats and middlings. No cockle found. Feeding developed no unfavorable symptoms in animals fed.

TABLE II. ANALYSES OF FEEDING STUFFS SUBMITTED BY INDIVIDUALS—*Continued.*

Station No.	Material	Submitted by	Pounds per Hundred: Water	Ash	Protein (N x 6.25)	Fiber	Nitrogen-free extract (starch, gum, etc.)	Ether extract (crude fat)	Remarks
	MISCELLANEOUS—*Continued.*								
2017	Scratch Feed	*E. Granby:* B. A. Krick	....	....	....	....	....	....	Consisted of cracked corn, barley, wheat, oats, weed seeds. Slight musty odor. Feeding tests developed no unfavorable symptoms in animals fed.
2607	Unknown Salt. (Found in pasture)	*Hartford:* Commissioner on Domestic Animals	....	....	....	....	....	....	Identified as potassium nitrate or saltpeter.
2399 2400	Mash Beef Scrap	*Pleasant Village:* Birchwood Farm Co., Inc.	....	....	....	....	....	....	No alkaloids or mineral poisons detected. White rats and chicks fed with both mash and scrap for period of three days developed no unfavorable symptoms.
2167 2168	Mixed Grain Mash	*West Cheshire:* Reno Swift	....	....	....	....	....	....	Feeds clean and wholesome apparently. No indication of salt. Feeding tests developed no unfavorable symptoms in animals fed.

TABLE II. ANALYSES OF FEEDING STUFFS SUBMITTED BY INDIVIDUALS—*Concluded.*

Station No.	Material	Submitted by	Pounds per Hundred						Remarks
			Water	Ash	Protein (N x 6.25)	Fiber	Nitrogen-free extract (starch, gum, etc.)	Ether extract (crude fat)	
	MISCELLANEOUS—*Concluded.*								
1476	Calf Meal	*So. Norwalk:* Sam'l Roodner	....	....	....	....	....	....	No poisons indicated by chemical tests or by feeding trials.
1410	(1) Portion of cow's stomach; (2) Stomach contents, (3) mixed feed; (4) cottonseed meal	*Hartford:* Commissioner on Domestic Animals	....	....	....	....	....	....	Nitrate indicated in the inflamed stomach tissue. Arsenic, mercury, lead, barium, copper, phosphorus and cyanide not detected. Alkaloids not found. No evidence of poison except the possible presence of nitrates.
1689	Stock Salt	*Rockfall:* D. Howard Birdsey	....	....	....	....	....	....	Not common salt but magnesium sulphate (Epsom salt).

Tonics, Conditioners, Remedies, etc.

3352. *Mineral Mixture* for use in feeds. Sample submitted by Mulberry Shell Co. Composed of salt, sulphur, charcoal, shell and gravel. Salt, sulphur and charcoal did not correspond to the formula used in mixing, due, probably, to the difficulty in mixing such materials and the tendency to stratify upon handling afterwards.

3353. *Coot Shell Clam*, screened. Submitted by the company named above. Consisted of approximately 66 per cent of shell and 29 per cent of sand, gravel, etc.

3354. *Coot Shell Clam*, unscreened. Submitted by the company named above. Consisted of approximately 76 per cent of shell and 18 per cent of sand, gravel, etc.

3160. *Zip Stock Conditioner.* Zip Products Co., Tiffin, Ohio. Sample submitted by John Robb, Middletown. Ingredients claimed to be present are sulphur, quassia, copperas, Glauber's salt, fenugreek, sodium chloride, palmo meal and charcoal. A substance resembling palm nut meal was present and all of the other materials claimed were identified.

915. *Bowman's Abortion Remedy.* Erick Bowman Remedy Co., Inc., Owatonna, Minn. This remedy was called to our attention by a dairyman whose herd was infected with contagious abortion by reason of which he had sustained serious losses in the past few years. While not too sanguine of the efficacy of any advertised "specific," preliminary trials appeared to have produced favorable results and a substantial supply of the remedy was procured at a considerable cost. The disease was not eliminated from his herd, however, and at the time of submitting the sample the purchaser was in doubt as to the value of the treatment.

Examination of the remedy showed that it consisted of some ordinary feeding material, probably bran, with about 85 per cent of brown sugar, and chlorides, calculated as sodium chloride, equivalent to 0.71 per cent. The analysis further indicated the presence of some vegetable extractive or other medicament. The proximate analysis accounted for about 99 per cent of the sample but active medicaments, if present, were not identified.

So far as we are aware, the only progress which has been made in controlling this disease is by the method of strict isolation of infected animals; the efficacy of specifics given by mouth, or otherwise, has not been demonstrated by adequate acceptable evidence.

21664. *Lictonic.* Lambert Lictonic Co., St. Louis, Mo. This preparation, in the form of a black compressed cake, is said to contain practically all the drugs, herbs, and mineral substances which have been recommended from time to time by various

authorities as desirable adjuncts to the rations of farm animals. Reference is made in accompanying literature to official and other feeding tests which appear to substantiate the claims made for the product.

We have no first-hand information about this preparation from the standpoint of actual feeding experience, but a sample submitted to us showed on analysis substantially the following *composition*:

Moisture 2.50 per cent; organic matter (loss on ignition less moisture and free sulphur), 13.83 per cent; nitrogen 0.27 per cent; sodium chloride 50.24 per cent; calcium sulphate 15.10 per cent; calcium carbonate 9.21 per cent; magnesium carbonate 1.07 per cent; iron and aluminum oxides 2.85 per cent; silicon dioxide 2.71 per cent; undetermined, including phosphorus if present, 0.57 per cent; free sulphur 1.92 per cent.

BULLETIN 278 MAY, 1926

Connecticut Agricultural Experiment Station

New Haven, Connecticut

A Chemical Investigation of Some Standard Spray Mixtures

R. E. ANDREW AND PHILIP GARMAN

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THE TUTTLE, MOREHOUSE & TAYLOR COMPANY

A Chemical Investigation of Some Standard Spray Mixtures

R. E. Andrew* and Philip Garman

Modern spray practices have become complicated procedures. The necessity of attaining maximum efficiency with a minimum of labor has led in the case of fruit growing to the use of high powered outfits which apply spray mixtures at a rapid rate and to the combination of sprays in order to avoid separate applications. In the combination of sprays there has been much uncertainty of results and failure to explain certain phenomena which have not been well understood, at least from a chemical standpoint. For instance, we know that the ingredients of a certain spray formula mixed in a certain order give a definitely colored mixture, whereas an entirely different order of combination may give a different appearance. What goes on under these conditions as regards the ingredients themselves has only been conjectured by the entomologist, and it is in an attempt to throw some further light on what happens when various insecticides and fungicides are put together that the present work was undertaken.

Historical Summary

Probably the earliest studies of spray mixtures from a chemical standpoint were made by Bradley[2] and Bradley and Tartar[3], who found that there was a distinct chemical reaction between lime-sulphur and lead arsenate resulting in the formation of soluble arsenic. The latter undesirable condition was found to be greatly helped by the addition of lime to the mixture. Robinson[15], following this clue, described the beneficial action of lime upon the standard spray mixture and came to the conclusion that lime prevents the reaction between lime-sulphur and lead arsenate and does not lower the polysulphide sulphur in the lime-sulphur to a harmful extent. Ruth[17] made an extensive investigation of spray mixtures from a chemical standpoint, reaching the general conclusion that when these two components are mixed, a thioarsenate of some kind is formed which holds it insoluble in lime-sulphur solution, and that thiosulphates and sulphites are increased, possibly accounting for the improved fungicidal properties of the mixture. More recently Thatcher and Streeter[22] have investigated the addition of casein, gelatin,

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nicotine and other preparations to the combined lead arsenate, lime-sulphur sprays, finding that casein-lime and nicotine exert a beneficial action upon the spray mixture. Still more recently, with the use of somewhat different methods, Goodwin and Martin[10] reached somewhat different conclusions, stating that casein and gelatin do not always protect lead arsenate from harmful reactions with lime-sulphur and in fact give an increased amount of soluble arsenic, contrary to the conclusions of Thatcher and Streeter. They found furthermore that lime decreased the amount of sulphur in solution in the spray mixture, thereby reducing its fungicidal value, but that lime, if carbonated, exerted little or no effect upon the mixture.

Plan of Study and Methods Employed

All of the work thus far described was done with double or triple combinations of spray materials but the possible effect upon the composition of the mixture due to the sequence in which the separate ingredients were added was not considered. The work herein reported began with a study of the effect of different orders of mixing upon the composition of a mixture containing four ingredients, but as the work progressed it seemed advisable to extend its scope to include all possible double and triple combinations as well.

In preparing the experimental mixtures the conditions obtaining in practical spraying operations were followed as closely as possible. Thus, the materials used were market products of standard grades, and the proportions in which they were mixed, and the method of mixing, are fairly representative of field practice. It will be seen that the period of agitation was one hour, which is about the maximum time required to apply a two hundred gallon tank of spray mixture, using one gun or two rods. With many outfits much less time than this would be required so that this agitation period is probably nearer the maximum than the minimum for the average spray rig.

FORMULA

The complete formula used and its equivalent in actual spraying practice are as follows:

	Experimental Mixture	Corresponding Field Practice
(1) Arsenate of lead (acid)	2.4 grams	4.0 pounds
(2) Nicotine sulphate	0.6 cc	0.96 pint
(3) Casein-lime	0.55 grams	0.917 pounds
(4) Lime-sulphur	14.5 cc	2.6 gallons
(5) Water (distilled), to make	500.0 cc	100.0 gallons

PREPARATION OF EXPERIMENTAL MIXTURES

In mixing the ingredients, whatever the number chosen, the final volume was brought to 500 cc and the manipulation was uniformly as follows:

Place about 485 cc of water in a 500 cc graduated shaking flask. Add the ingredients separately, in the amounts indicated by the formula, shaking by hand for two minutes after each addition. Stopper the flask securely, place in a shaking machine of the revolving type and agitate the mixture for one hour. Remove the flask from the shaking device and allow the mixture to stand for one hour. Filter on a 9 cm filter paper using a Buchner funnel with gentle suction, transferring as much of the insoluble material as possible to the filter. Do not rinse the flask or wash the residue upon the filter. Transfer the yellow filtrate (A), to a suitable flask, stopper, and hold for analysis.

Return the filter with the insoluble residue to the original graduated shaking flask and wash into the flask also any of the insoluble residue which may have adhered to the funnel. Fill the flask to the 500 cc mark, stopper securely, place in the shaking machine and agitate the contents for one hour. Remove the flask from the shaking device and allow to stand for one hour, after which filter through a large filter. Do not wash the residue. Reserve the filtrate, solution (B), for analysis.

EXAMINATION OF MIXTURES

The various experimental mixtures were examined with reference to certain physical characteristics and to chemical composition, the latter being confined to determinations of total sulphur in the lime-sulphur solution (filtrate A), and of total arsenic, as arsenic pentoxide (As_2O_5), both in filtrate A and filtrate B. The results obtained for total sulphur are of interest as an index to the extent of chemical change which has taken place in the mixture so far, at least, as the sulphur originally present has been converted into insoluble forms. Foliage injury, in part, results from excessive amounts of soluble arsenic in the lime-sulphur solution; and it seems not improbable that the insoluble arsenic-containing residue which is deposited upon foliage in the process of spraying might become, upon exposure to weather conditions, a potential source of further injury. For this reason the water-soluble arsenic in the insoluble residue was determined.

METHODS OF ANALYSIS

The determination of the small amounts of soluble arsenic involved in preparations made on the scale of these laboratory mixtures presented some difficulty. After some preliminary trials, the method used by Bradley[2] and by others whereby sulphur is oxidized by means of hydrogen peroxide and arsenic finally titrated with dilute iodine solution appeared to be promising. The results, however, were not satisfactory and the method is objec-

tionable chiefly for the following reasons: it requires large quantities of a relatively expensive reagent (hydrogen peroxide); the evaporation of a large volume of liquid is time consuming; the filtration of the large amount of sediment which forms during the evaporation, and the necessary washing, introduce potential errors; and finally, the iodine titration does not give a sharply defined end point.

About this time Cox[5] published a critical review of certain methods for the determination of small quantities of arsenic, citing particularly the methods of Bang and Ramberg, his experience favoring the last named. As pointed out by Cox, neither method involves any new principle, but, on trial, the Ramberg method was found to be adaptable to our problem. Briefly, the procedure consists in oxidizing the sulphur and destroying organic matter by digestion with nitric and sulphuric acids, removing the excess of nitric acid by means of ammonium oxalate, distilling with hydrochloric acid and titrating the arsenic with potassium bromate solution, using methyl orange (1 : 5000) as as indicator.

The digestion was conducted in a long-neck Kjeldahl flask made to fit a condensing tube with a ground glass joint; thus the digestion and distillation were both made without a transfer of material. Arsenic-free reagents, tested by means of suitable blanks, were used throughout. The standard potassium bromate solution was prepared of such strength that 1 cc was equivalent to 0.0005 gm. of arsenic pentoxide (As_2O_5).

The procedure in detail as used by us is as follows:

Arsenic in lime-sulphur solution (*Solution A*). Transfer 100 cc of the solution to the digestion-distillation flask, add a few glass beads, 50 cc of concentrated nitric acid and evaporate over a low flame until the volume is reduced to about 25 cc. Cool, add 25 cc of concentrated sulphuric acid and heat until fumes of sulphuric acid appear. From a suitable dropping device add 50 cc of concentrated nitric acid dropwise, meanwhile boiling the solution very gently. Continue the boiling until sulphuric acid fumes appear. Cool, add 25 cc of saturated ammonium oxalate solution and again boil until fumes of sulphuric acid are noticed. Cool, rinse the neck of the flask with 20 cc of water and then add 2 grams of ferrous sulphate, 50 cc of concentrated hydrochloric acid and 0.1 gram of potassium bromide. (*If any yellow or brown color appears at this point nitrogen acids are present and the experiment must be rejected.*) Connect the flask with the condensing tube, adjust a receiving flask containing 150 cc of water, and allow the condenser to dip about 1 cm. below the surface of the liquid therein. Distill at such a rate that 20 to 25 cc of distillate are obtained in about 10 minutes. Heat the distillate to 50° C., add three drops of methyl orange and titrate at once with standard potassium bromate solution, adding this reagent very slowly as the end point is approached. The end point is reached when the red color of the indicator is discharged. Each cc of potassium bromate used corresponds to 0.0005 gram of As_2O_5.

Arsenic in Solution B. Transfer 50 cc of the solution to the digestion-distillation flask, add 50 cc of concentrated nitric acid and evaporate over a low flame until the volume is reduced to about 25 cc. Cool, add 25 cc of concentrated sulphuric acid and boil until sulphuric acid fumes appear.

Cool, add 10 cc of concentrated nitric acid and again heat until fumes of sulphuric acid are noted. Cool, add 25 cc of saturated ammonium oxalate solution and from this point proceed as directed in the previous paragraph.

Total sulphur in Solution A. Total sulphur was determined substantially according to the official procedure[1] except that oxidation of sulphur was effected by means of hydrogen peroxide in alkaline solution as allowed by a former optional method.[13]

Transfer 10 cc of solution A to a 250 cc beaker containing 10 cc of a 10 per cent solution of sodium hydroxide, 50 cc of water and 50 cc of hydrogen peroxide. Cover the beaker with a watch glass and heat for one hour on a steam bath. Cool, acidify with dilute hydrochloric acid (1 to 1), and precipitate the sulphur as barium sulphate. Calculate the percentage of sulphur from the weight of barium sulphate, using the factor 0.1374.

PRELIMINARY EXPERIMENTS

The adaptability of the method for the determination of arsenic as described may be illustrated by the following experiments. Blanks on the reagents, in the amounts used in the method, showed titerable substances equivalent to 0.3 cc of standard potassium bromate and this correction was uniformly made in all determinations.

	Arsenic, as As_2O_5			
Material	Present gm.	Added gm.	Total gm.	Recovered gm.
100 cc water+1 gm. sugar	......	0.01160	0.01160	0.01160
100 cc water+1 gm. sugar	......	0.01160	0.01160	0.01160
Lime-sulphur-Lead arsenate	0.00613	0.01160	0.01773	0.01775
		0.01160	0.01773	0.01773

INTERPRETATION OF RESULTS

In the analytical data herein reported total sulphur is expressed in terms of grams per 100 cc of the lime-sulphur solution. Arsenic is expressed in percentages of As_2O_5 based on the amount of lead arsenate, 2.4 grams, present in the mixture.

In the tables also abbreviations are necessary and the following are used: L.A. = Lead arsenate; L.S. = Lime-sulphur; N. S. = Nicotine sulphate; C.L. = Casein-Lime; L. = Lime; Blk. = Black; G. = Grey; G.B. = Greyish-black.

TABLE 1. EFFECT OF COMBINING LIME-SULPHUR WITH LEAD ARSENATE

Exp. No.	Order of Mixing*				Physical Characteristics			Arsenic, As_2O_5, per cent. Based on amount of lead arsenate used			Total Sulphur In Lime-Sulphur solution gm/100 cc
	1	2	3	4	Color of finished mixture	Color of sediment	Filtered solution	In L.-S. solution %	Water-soluble in sediment %	Total soluble %	
A-1	L. A.	....	....	....	....	....	....	....	0.05	0.05	....
A-2	L. S.	....	....	....	....	....	....	....	....	....	.923
B-1	L. A.	L. S.	....	....	....	....	....	0.98	5.48	6.46	.907
B-2	L. S.	L. A.	....	....	....	....	....	1.49	5.72	7.21	.890

TABLE 2. EFFECT OF ADDING LIME-SULPHUR TO LEAD ARSENATE AND NICOTINE SULPHATE ALREADY IN COMBINATION AND OF COMBINING IT WITH THESE INGREDIENTS IN OTHER WAYS

Exp. No.	1	2	3	4	Color of finished mixture	Color of sediment	Filtered solution	In L.-S. solution %	Water-soluble in sediment %	Total soluble %	Total Sulphur gm/100 cc
B-3	L. A.	N. S.	....	....	....	....	....	....	0.06	0.06	....
B-4	N. S.	L. A.	....	....	....	....	....	....	0.03	0.03	....
C-2	L. A.	N. S.	L. S.	....	Light	G. B.	Clear	1.03	4.20	5.23	.890
C-1	L. A.	L. S.	N. S.	....	Light	Blk.	Clear	1.74	0.52	2.26	.604
C-3	L. S.	L. A.	N. S.	....	Light	Blk.	Clear	1.28	0.30	1.58	.611
C-4	L. S.	N. S.	L. A.	....	Light	G. B.	Clear	1.77	4.63	6.40	.820
C-5	N. S.	L. S.	L. A.	....	Light	G. B.	Clear	1.06	4.40	5.46	.884
C-6	N. S.	L. A.	L. S.	....	Light	G. B.	Clear	1.06	3.78	4.84	.873

TABLE 3. EFFECT OF ADDING LIME-SULPHUR TO LEAD ARSENATE, NICOTINE SULPHATE AND CASEIN-LIME ALREADY IN COMBINATION, AND OF COMBINING IT WITH THESE INGREDIENTS IN OTHER WAYS

Exp. No.	Order of Mixing				Physical Characteristics			Arsenic, As_2O_5, per cent. Based on amount of lead arsenate used			Total Sulphur In *Lime-Sulphur* solution gm/100 cc
	1	2	3	4	Color of finished mixture	Color of sediment	Filtered solution	In L.-S. solution %	Water-soluble in sediment %	Total soluble %	
C-14	L. A.	N. S.	C. L.	....	....	....	Turbid	0.20	0.48	0.68	....
1	L. A.	N. S.	C. L.	L. S.	Light	G. B.	Clear	0.40	2.55	2.95	.930
12	L. S.	L. A.	N. S.	C. L.	Light	Blk.	Clear	0.90	0.41	1.31	.678
C-13	L. A.	C. L.	N. S.	....	....	....	Turbid	0.30	0.60	0.90	....
2	L. A.	C. L.	N. S.	L. S.	Dark	G. B.	Clear	0.47	2.83	3.30	.925
9	L. S.	L. A.	C. L.	N. S.	Light	G. B.	Turbid	0.47	0.98	1.45	.907
C-15	C. L.	L. A.	N. S.	....	....	....	Turbid	0.31	0.56	0.87	....
8	C. L.	L. A.	N. S.	L. S.	Dark	G. B.	Clear	0.60	2.65	3.25	.916
15	L. S.	C. L.	L. A.	N. S.	Dark	G. B.	Turbid	0.55	1.35	1.90	.912
C-16	N. S.	L. A.	C. L.	....	....	....	Turbid	0.23	0.40	0.63	....
7	N. S.	L. A.	C. L.	L. S.	Light	G. B.	Clear	0.39	2.55	2.94	.919
16	L. S.	N. S.	L. A.	C. L.	Light	Dark	Clear	0.65	2.40	3.05	.838
C-17	N. S.	C. L.	L. A.	....	....	....	Turbid	0.25	0.94	1.19	....
17	N. S.	C. L.	L. A.	L. S.	Light	G. B.	Clear	0.41	2.56	2.97	.906
23	L. S.	N. S.	C. L.	L. A.	Light	G. B.	Turbid	0.39	1.40	1.79	.907
C-18	C. L.	N. S.	L. A.	....	....	....	Clear	0.30	1.20	1.50	....
14	C. L.	N. S.	L. A.	L. S.	Dark	G. B.	*Turbid*	0.33	2.77	3.10	.920
	L. S.	C. L.	N. S.	L. A.	Dark	G. B.	Clear	0.48	1.71	2.19	.916

Discussion

Effect of Adding Lime-Sulphur to Different Ingredients Separately and Combined (Tables 1 to 3)

It will be seen that addition of lime-sulphur to lead arsenate brings about a tremendous increase in soluble arsenic,—nearly 136 times the original content of the lead arsenate alone. When lime-sulphur is added to nicotine sulphate and lead arsenate in combination there is likewise a great increase,—34 to 140 times, while in the complete quadruple combination the increase is not so great, due probably to addition of casein-lime in the mixture. It is thus evident that there is an important reaction between lime-sulphur and lead arsenate, but that this is not increased by nicotine sulphate, and is lessened when casein-lime is added.

Exp. No.	Order of Mixing 1	2	3	4	Physical Characteristics: Color of finished mixture	Color of sediment	Filtered solution	Arsenic, As_2O_5, per cent. Based on amount of lead arsenate used: In L.-S. solution %	Water-soluble in sediment %	Total soluble %	*Total* Sulphur In Lime-Sulphur solution *gm/100 cc*
Table 4. Effect of Combining Nicotine Sulphate with Lead Arsenate and Lime-Sulphur											
A-1	L. A.	....	....	....	....	....	....	....	0.05	0.05	....
B-3	L. A.	N. S.	....	....	....	....	....	....	0.06	0.06	....
B-4	N. S.	L. A.	....	....	....	....	....	....	0.03	0.03	....
A-2	L. S.	....	....	....	....	....	....	....	....	....	.923
B-7	L. S.	N. S.	....	....	....	....	....	....	....	....	.933
B-8	N. S.	L. S.	....	....	....	....	....	....	....	....	.928
Table 5. Effect of Adding Nicotine Sulphate to Lime-Sulphur and Casein-Lime Already in Combination and of Combining It with These Ingredients in Other Ways											
B-9	L. S.	C. L.	....	....	....	....	....	....	....	....	.916
B-10	C. L.	L. S.	....	....	Light	....	....	....	....	....	.905
C-20	L. S.	C. L.	N. S.	....	....	....	....	....	....	....	.930
C-22	C. L.	L. S.	N. S.	....	....	....	....	....	....	....	.936
Table 6. Effect of Adding Nicotine Sulphate to Lead Arsenate and Casein-Lime Already in Combination and of Combining It with These Ingredients in Other Ways											
B-5	L. A.	C. L.	....	....	....	....	....	....	0.28	0.28	....
B-6	C. L.	L. A.	....	....	....	....	....	....	0.28	0.28	....
C-13	L. A.	C. L.	N. S.	....	....	....	....	0.30*	0.60	0.90	....
C-15	C. L.	L. A.	N. S.	....	....	....	....	0.31*	0.56	0.87	....

* Soluble in water.

TABLE 7. EFFECT OF ADDING NICOTINE SULPHATE TO LEAD ARSENATE AND LIME-SULPHUR ALREADY IN COMBINATION AND OF COMBINING IT WITH THESE INGREDIENTS IN OTHER WAYS

Exp. No.	Order of Mixing 1	2	3	4	Physical Characteristics: Color of finished mixture	Color of sediment	Filtered solution	Arsenic, As_2O_5, per cent. Based on amount of lead arsenate used: In L.-S. solution %	Water-soluble in sediment %	Total soluble %	Total Sulphur In Lime-Sulphur solution gm/100 cc
B-1	L. A.	L. S.	....	....	Light	G. B.	Clear	0.98	5.48	6.46	.907
B-2	L. S.	L. A.	....	....	Light	G. B.	Clear	1.49	5.72	7.21	.890
C-1	L. A.	L. S.	N. S.	....	Light	Blk.	Clear	1.74	0.52	2.26	.604
C-3	L. S.	L. A.	N. S.	....	Light	Blk.	Clear	1.28	0.30	1.58	.611
C-5	N. S.	L. S.	L. A.	....	Light	G. B.	Clear	1.06	4.40	5.46	.884
C-6	N. S.	L. A.	L. S.	....	Light	G. B.	Clear	1.06	3.78	4.84	.873
C-4	L. S.	N. S.	L. A.	....	Light	G. B.	Clear	1.77	4.63	6.40	.820
C-2	L. A.	N. S.	L. S.	....	Light	G. B.	Clear	1.03	4.20	5.23	.890

TABLE 8. EFFECT OF ADDING NICOTINE SULPHATE TO LEAD ARSENATE, CASEIN-LIME AND LIME-SULPHUR ALREADY IN COMBINATION AND OF COMBINING IT WITH THESE INGREDIENTS IN OTHER WAYS

Exp. No.	Order of Mixing 1	2	3	4	Color of finished mixture	Color of sediment	Filtered solution	In L.-S. solution %	Water-soluble in sediment %	Total soluble %	Total Sulphur In Lime-Sulphur solution gm/100 cc
C-7	L. A.	C. L.	L. S.	....	Light	G. B.	Turbid	0.41	2.58	2.99	.915
6	L. A.	C. L.	L. S.	N. S.	Dark	G. B.	Turbid	0.50	2.33	2.83	.916
7	N. S.	L. A.	C. L.	L. S.	Light	G. B.	Clear	0.39	2.55	2.94	.919
C-8	L. A.	L. S.	C. L.	....	Light	G. B.	Turbid	0.35	1.56	1.91	.916
3	L. A.	L. S.	C. L.	N. S.	Light	G. B.	Turbid	0.43	1.19	1.62	.915
10	N. S.	L. A.	L. S.	C. L.	Light	G. B.	Turbid	0.29	1.33	1.62	.912
C-9	C. L.	L. A.	L. S.	....	Dark	L. G.	Clear	0.40	2.56	2.96	.928
11	C. L.	L. A.	L. S.	N. S.	Dark	G. B.	Clear	0.69	2.60	3.29	.918
17	N. S.	C. L.	L. A.	L. S.	Light	G. B.	Clear	0.41	2.56	2.97	.906
C-10	L. S.	L. A.	C. L.	....	Light	G. B.	Turbid	0.40	1.93	2.33	.920
9	L. S.	L. A.	C. L.	N. S.	Light	G. B.	Turbid	0.47	0.98	1.45	.907
13	N. S.	L. S.	L. A.	C. L.	Light	Blk.	Clear	0.55	2.31	2.86	.800
C-11	L. S.	C. L.	L. A.	....	Light	G. B.	Turbid	0.46	1.91	2.37	.920
15	L. S.	C. L.	L. A.	N. S.	Dark	G. B.	Turbid	0.55	1.35	1.90	.912
19	N. S.	L. S.	C. L.	L. A.	Light	G. B.	Turbid	0.40	1.06	1.46	.907
C-12	C. L.	L. S.	L. A.	....	Light	G. B.	Turbid	0.45	2.52	2.97	.922
18	C. L.	L. S.	L. A.	N. S.	Dark	G. B.	Turbid	0.50	2.80	3.30	.922
24	N. S.	C. L.	L. S.	L. A.	Dark	G. B.	Clear	0.48	2.73	3.21	.916

Effect of Adding Nicotine Sulphate to Different Ingredients Separately and Combined

(Tables 4 to 8)

A study of Tables 4 to 8 shows that there is a negligible action when nicotine sulphate and lime-sulphur are mixed together as regards total sulphur in solution. There is likewise little or no action when nicotine sulphate and lead arsenate are mixed together. When nicotine sulphate is added to lime-sulphur and casein-lime in *combination, not so much sulphur is precipitated* from the solution although the difference is small and of doubtful importance. When added to lead arsenate and casein-lime there is a distinct increase in soluble arsenic and when nicotine sulphate is added to lead arsenate and lime-sulphur in combination there is a decrease in soluble arsenic, and also a decrease in the amount of sulphur in solution. Added to triple combinations as in Table 8, there are variable results. The sulphur content of the filtrate is only slightly altered and the soluble arsenic is decreased in 8 cases but increased in 4.

TABLE 9. EFFECT OF COMBINING CASEIN-LIME WITH LEAD ARSENATE AND LIME-SULPHUR

Exp. No.	Order of Mixing				Physical Characteristics			Arsenic, As_2O_5, per cent. Based on amount of lead arsenate used			Total Sulphur In Lime-Sulphur solution gm/100 cc
	1	2	3	4	Color of finished mixture	Color of sediment	Filtered solution	In L.-S. solution %	Water-soluble in sediment %	Total soluble %	
A-1	L. A.	....	....	....	....	....	....	....	0.05	0.05	....
B-5	L. A.	C. L.	....	....	....	....	....	....	0.28	0.28	....
B-6	C. L.	L. A.	....	....	....	....	....	....	0.28	0.28	....
A-2	L. S.	....	....	....	....	....	....	....	....	....	.923
B-9	L. S.	C. L.	....	....	....	....	....	....	....	....	.916
B-10	C. L.	L. S.	....	....	Light	....	....	....	....	....	.905

TABLE 10. EFFECT OF ADDING CASEIN-LIME TO LEAD ARSENATE AND LIME-SULPHUR ALREADY IN COMBINATION AND OF COMBINING IT WITH THESE INGREDIENTS IN OTHER WAYS

Exp. No.	1	2	3	4	Color of finished mixture	Color of sediment	Filtered solution	In L.-S. solution %	Water-soluble in sediment %	Total soluble %	Total Sulphur gm/100 cc
B-1	L. A.	L. S.	....	....	Light	G. B.	Clear	0.98	5.48	6.46	.907
B-2	L. S.	L. A.	....	....	Light	G. B.	Clear	1.49	5.72	7.21	.890
C-8	L. A.	L. S.	C. L.	....	Light	G. B.	Turbid	0.35	1.56	1.91	.916
C-10	L. S.	L. A.	C. L.	....	Light	G. B.	Turbid	0.40	1.93	2.33	.920
C-7	L. A.	C. L.	L. S.	....	Light	G. B.	Turbid	0.41	2.58	2.99	.915
C-9	C. L.	L. A.	L. S.	....	Dark	L. G.	Clear	0.40	2.56	2.96	.928
C-11	L. S.	C. L.	L. A.	....	Light	G. B.	Turbid	0.46	1.91	2.37	.920
C-12	C. L.	L. S.	L. A.	....	Light	G. B.	Turbid	0.45	2.52	2.97	.922

TABLE 11. EFFECT OF ADDING CASEIN-LIME TO LEAD ARSENATE AND NICOTINE SULPHATE ALREADY IN COMBINATION AND OF COMBINING IT WITH THESE INGREDIENTS IN OTHER WAYS

Exp. No.	1	2	3	4	Color of finished mixture	Color of sediment	Filtered solution	In L.-S. solution %	Water-soluble in sediment %	Total soluble %	Total Sulphur gm/100 cc
B-3	L. A.	N. S.	....	....	....	....	....	....	0.06	0.06	....
B-4	N. S.	L. A.	....	....	....	....	....	....	0.03	0.03	....
C-14	L. A.	N. S.	C. L.	....	....	....	Turbid	0.20	0.48	0.68	....
C-16	N. S.	L. A.	C. L.	....	Clear	....	Turbid	0.23	0.40	0.63	....
C-13	L. A.	C. L.	N. S.	....	Clear	....	Turbid	0.30	0.60	0.90	....
C-15	C. L.	L. A.	N. S.	....	Clear	....	Turbid	0.31	0.56	0.87	....
C-17	N. S.	C. L.	L. A.	....	Clear	....	Turbid	0.25	0.94	1.19	....
C-18	C. L.	N. S.	L. A.	....	Clear	....	Clear	0.30	1.20	1.50	....

TABLE 12. EFFECT OF ADDING CASEIN-LIME TO LIME-SULPHUR AND NICOTINE SULPHATE IN COMBINATION AND OF COMBINING IT WITH THESE INGREDIENTS IN OTHER WAYS

Exp. No.	Order of Mixing 1	2	3	4	Physical Characteristics: Color of finished mixture	Color of sediment	Filtered solution	Arsenic, As_2O_5, per cent. Based on amount of lead arsenate used: In L.-S. *solution* %	Water-soluble *in sediment* %	Total soluble %	Total Sulphur In Lime-Sulphur solution gm/100 cc
B-7	L. S.	N. S.	....	....	....	....	....	....	....	....	.933
B-8	N. S.	L. S.	....	....	....	....	....	....	....	....	.928
C-19	L. S.	N. S.	C. L.	....	Dark	....	....	....	....	....	.925
C-21	N. S.	L. S.	C. L.	....	Dark	....	....	....	....	....	.930
C-20	L. S.	C. L.	N. S.	....	....	....	....	....	....	....	.930
C-22	C. L.	L. S.	N. S.	....	....	....	....	....	....	....	.936
C-23	N. S.	C. L.	L. S.	....	....	....	....	....	....	....	.934
C-24	C. L.	N. S.	L. S.	....	....	....	....	....	....	....	.935

TABLE 13. EFFECT OF ADDING CASEIN-LIME TO LEAD ARSENATE, NICOTINE SULPHATE AND LIME-SULPHUR IN COMBINATION AND OF COMBINING IT WITH THESE INGREDIENTS IN OTHER WAYS

Exp. No.	1	2	3	4	Color of finished mixture	Color of sediment	Filtered solution	In L.-S. solution %	Water-soluble in sediment %	Total soluble %	Total Sulphur gm/100 cc
C-1	L. A.	L. S.	N. S.	....	Light	Blk.	Clear	1.74	0.52	2.26	.604
4	L. A.	L. S.	N. S.	C. L.	Light	Blk.	Turbid	0.71	1.62	2.33	.827
11	C. L.	L. A.	L. S.	N. S.	Dark	G. B.	Clear	0.69	2.60	3.29	.918
C-2	L. A.	N. S.	L. S.	....	Light	G. B.	Clear	1.03	4.20	5.23	.890
5	L. A.	N. S.	L. S.	C. L.	Light	Blk.	Clear	0.81	0.29	1.10	.716
8	C. L.	L. A.	N. S.	L. S.	Dark	G. B.	Clear	0.60	2.65	3.25	.916
C-3	L. S.	L. A.	N. S.	....	Light	Blk.	Clear	1.28	0.30	1.58	.611
12	L. S.	L. A.	N. S.	C. L.	Light	Blk.	Clear	0.90	0.41	1.31	.678
18	C. L.	L. S.	L. A.	N. S.	Dark	G. B.	Turbid	0.50	2.80	3.30	.922
C-4	L. S.	N. S.	L. A.	....	Light	G. B.	Clear	1.77	4.63	6.40	.820
16	L. S.	N. S.	L. A.	C. L.	Light	Dark	Clear	0.65	2.40	3.05	.838
20	C. L.	L. S.	N. S.	L. A.	Dark	G. B.	Clear	0.50	2.69	3.19	.906
C-5	N. S.	L. S.	L. A.	....	Light	G. B.	Clear	1.06	4.40	5.46	.884
13	N. S.	L. S.	L. A.	C. L.	Light	Blk.	Clear	0.55	2.31	2.86	.800
22	C. L.	N. S.	L. S.	L. A.	Dark	G. B.	Clear	0.41	2.54	2.95	.913
C-6	N. S.	L. A.	L. S.	....	Light	G. B.	Clear	1.06	3.78	4.84	.873
10	N. S.	L. A.	L. S.	C. L.	Light	G. B.	Turbid	0.29	1.33	1.62	.912
14	C. L.	N. S.	L. A.	L. S.	Dark	G. B.	Turbid	0.33	2.77	3.10	.920

Effect of Adding Casein-Lime to Different Ingredients Separately and Combined

(Tables 9 to 13)

It will be seen from Table 9 that the addition of casein-lime increased the soluble arsenic and reduced the sulphur when mixed with lead arsenate and lime-sulphur alone. When added to lead arsenate and lime-sulphur in combination, the amount of soluble arsenic is greatly reduced and the sulphur in solution is increased.

When added to nicotine sulphate and lead arsenate in combination the soluble arsenic is distinctly increased, but when added to lime-sulphur and nicotine sulphate the sulphur content of the solution is not greatly altered. In quadruple mixtures, Table 13, there seems to be, in general, an increase of sulphur in solution where casein-lime is used over mixtures where this material is omitted; and, in general, the soluble arsenic is reduced, but it may sometimes be increased.

Effect of Replacing Casein-Lime with Pure Lime (Table 14)

In order to find out whether the casein or lime of the casein-lime mixture was responsible for the results noted in Tables 9 to 13, a quantity of pure lime (CaO), equivalent to the amount used in the casein-lime, was substituted (D1). This amount was then doubled (D2). It will be seen that the amount of soluble arsenic is decreased as much or more by lime alone as by casein-lime (Exp. No. 2): also that the amount of sulphur in solution is not greatly reduced by the additional lime.

Effect of Different Orders of Mixing on Quadruple Mixtures (Table 15)

It is easily demonstrated that different orders of mixing produce differently colored mixtures, but to determine if possible the value of this criterion for judging spray mixtures Table 15 was prepared. It will be seen that some of the mixtures are dark in color while others are light. It was noted in the course of the work that some of the blackness of the resulting spray was due to the mixture of lime-sulphur and nicotine sulphate as well as the formation of lead sulphide as noted by others. The actual color of the sediment does not vary greatly, but there is a considerable variation in the turbidity of the filtrate, certain ones remaining clear, while others produce a decided murkiness. The turbid filtrates were tested by chemical means and found to be due to a very finely divided sulphur and not to lead, calcium or

TABLE 14. EFFECT OF REPLACING CASEIN-LIME WITH PURE LIME, EQUAL IN AMOUNT AND DOUBLE THE ORIGINAL CONTENT OF THE CASEIN-LIME

Exp. No.	Order of Mixing 1	2	3	4	Physical Characteristics: Color of finished mixture	Color of sediment	Filtered solution	Arsenic, As_2O_5, per cent. Based on amount of lead arsenate used: In L.-S. solution %	Water-soluble in sediment %	Total soluble %	Total Sulphur In Lime-Sulphur solution gm/100 cc
C-2	L. A.	N. S.	L. S.	....	Light	G. B.	Clear	1.03	4.20	5.24	.890
D-1	L. A.	L.*	N. S.	L. S.	Light	G.	Clear	0.31	1.21	1.52	.921
D-2	L. A.	L.**	N. S.	L. S.	Light	G.	Clear	0.25	0.27	0.52	.915
2	L. A.	C. L.	N. S.	L. S.	Dark	G. B.	Clear	0.47	2.83	3.30	.925

* 0.3 gm.
** 0.6 gm.

TABLE 15. EFFECT OF DIFFERENT ORDERS OF MIXING ON QUADRUPLE MIXTURES

Exp. No.	1	2	3	4	Color of finished mixture	Color of sediment	Filtered solution	In L.-S. solution %	Water-soluble in sediment %	Total soluble %	Total Sulphur gm/100 cc
1	L. A.	N. S.	C. L.	L. S.	Light	G. B.	Clear	0.40	2.55	2.95	.930
2	L. A.	C. L.	N. S.	L. S.	Dark	G. B.	Clear	0.47	2.83	3.30	.925
3	L. A.	L. S.	C. L.	N. S.	Light	G. B.	Turbid	0.43	1.19	1.62	.915
4	L. A.	L. S.	N. S.	C. L.	Light	Blk.	Turbid	0.71	1.62	2.33	.827
5	L. A.	N. S.	L. S.	C. L.	Light	Blk.	Clear	0.81	0.29	1.10	.716
6	L. A.	C. L.	L. S.	N. S.	Dark	G. B.	Turbid	0.50	2.33	2.83	.916
7	N. S.	L. A.	C. L.	L. S.	Light	G. B.	Clear	0.39	2.55	2.94	.919
8	C. L.	L. A.	N. S.	L. S.	Dark	G. B.	Clear	0.60	2.65	3.25	.916
9	L. S.	L. A.	C. L.	N. S.	Light	G. B.	Turbid	0.47	0.98	1.45	.907
10	N. S.	L. A.	L. S.	C. L.	Light	G. B.	Turbid	0.29	1.33	1.62	.912
11	C. L.	L. A.	L. S.	N. S.	Dark	G. B.	Clear	0.69	2.60	3.29	.918
12	L. S.	L. A.	N. S.	C. L.	Light	Blk.	Clear	0.90	0.41	1.31	.678
13	N. S.	L. S.	L. A.	C. L.	Light	Blk.	Clear	0.55	2.31	2.86	.800
14	C. L.	N. S.	L. A.	L. S.	Dark	G. B.	Turbid	0.33	2.77	3.10	.920
15	L. S.	C. L.	L. A.	N. S.	Dark	G. B.	Turbid	0.55	1.35	1.90	.912
16	L. S.	N. S.	L. A.	C. L.	Light	Blk.	Clear	0.65	2.40	3.05	.838
17	N. S.	C. L.	L. A.	L. S.	Light	G. B.	Clear	0.41	2.56	2.97	.906
18	C. L.	L. S.	L. A.	N. S.	Dark	G. B.	Turbid	0.50	2.80	3.30	.922
19	N. S.	L. S.	C. L.	L. A.	Light	G. B.	Turbid	0.40	1.06	1.46	.907
20	C. L.	L. S.	N. S.	L. A.	Dark	G. B.	Clear	0.50	2.69	3.19	.906
21	L. S.	C. L.	N. S.	L. A.	Dark	G. B.	Clear	0.48	1.71	2.19	.916
22	C. L.	N. S.	L. S.	L. A.	Dark	G. B.	Clear	0.41	2.54	2.95	.913
23	L. S.	N. S.	C. L.	L. A.	Light	G. B.	Turbid	0.39	1.40	1.79	.907
24	N. S.	C. L.	L. S.	L. A.	Dark	G. B.	Clear	0.48	2.73	3.21	.916

nicotine. This fact is of some significance in spraying practices since it has been demonstrated that colloidal sulphurs are important fungicides.[28] Whether such combinations as these, however, contain enough colloidal sulphur to affect the efficiency of the spray has not been determined.

It will be noted that combinations showing the lowest arsenic in solution (Nos. 5 and 12) are both extremely low in soluble sulphur and that both filtrates are clear. It would probably not be wise to select merely on the basis of soluble arsenic and sulphur content alone, although we know from the work of Saffro[19] that spray injury may be caused by calcium polysulphides and to a less extent by calcium thiosulphate (p. 32). An attempt to avoid spray injury would, therefore, include selection of mixtures low in sulphur and arsenic in solution, but these would probably be reduced in fungicidal action since the filtrates are clear and the total sulphur, supposedly the active forms, is reduced 25% or more (Nos. 5 and 12). It is important to note that in all cases the greater part of the soluble arsenic is found in the residue which emphasizes the necessity of cleaning the spray tank frequently, in order to avoid accumulation of sludge from previous tanks, and the importance of ample agitation to avoid this difficulty.

General Conclusions

(1) The Bramberg method of determining small amounts of arsenic has been found adaptable to the determination of soluble arsenic in spray mixtures.

(2) *Lime-sulphur* reacts strongly with lead arsenate* giving increased soluble arsenic and decreased sulphur in solution. It reacts similarly with lead arsenate and nicotine sulphate in combination and with lead arsenate and casein-lime but the reaction is not as great in the latter case.

(3) *Nicotine sulphate* does not react with lead arsenate or with lime-sulphur so far as indicated by the chemical data; a color change is noted, the significance of which is not explained. When added to lead arsenate and casein-lime together the soluble arsenic is increased; added to lead arsenate and lime-sulphur together there is a marked decrease in soluble arsenic and also a decrease in the amount of sulphur in solution. When added to triple combinations of lead arsenate, casein-lime and lime-sulphur, variable results are noted.

(4) *Casein-lime* increases the soluble arsenic content of lead arsenate when mixed with it alone. When mixed with

* Acid lead arsenate is implied wherever lead arsenate is mentioned.

lime-sulphur alone the amount of sulphur in solution is somewhat reduced. When added to nicotine sulphate and lead arsenate the soluble arsenic is distinctly increased, but when added to lime-sulphur and nicotine sulphate the sulphur content of the solution is not greatly altered. In quadruple mixtures there is, in general, an increase of sulphur in solution due to the casein-lime and there is in general a decrease in soluble arsenic. The latter, however, may sometimes be increased.

(5) The lime in casein-lime is largely responsible for the decrease in soluble arsenic where this material is used.

(6) Different orders of mixing quadruple mixtures give different results, but so many factors are involved and the variations are so small that the selection of improved mixtures seems an impossibility.

(7) Colloidal sulphur is sometimes formed in the spray mixtures.

(8) The color of the resulting mixture is not a satisfactory means of judging a spray solution.

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The Genetics and Morphology of Some Endosperm Characters in Maize

P. C. MANGELSDORF

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The Genetics and Morphology of Some Endosperm Characters in Maize*

P. C. Mangelsdorf

Introduction

When Nawaschin in 1898 discovered the phenomenon of double fertilization in *Lilium* it was generally believed by botanists that such a peculiar mechanism was confined to this species and perhaps a few closely related ones. Later investigations have shown that it is widely distributed and that the endosperm of angiosperms, with perhaps a few exceptions, is the product of a sexual fusion, quite apart from that which gives rise to the embryo, and differing from the latter in that one male nucleus combines with two or more female nuclei, while the embryo results from a fusion in which both parents contribute equally.

Thus the endosperm of angiosperms is unique in several respects. It resembles its near relative, the embryo, in its sexual origin, but differs from the latter in structure, in capacity for continued development, and in ability to reproduce.

This unique sporophyte, if indeed, it may be called a sporophyte, achieves its highest development in the cereals, in which it constitutes the part which makes these plants of such great economic importance, and in which it gives evidence of its sexual origin by the expression of the hereditary factors which it receives from its two parents.

Mendelian characters which have their expression in the endosperm have been found in wheat, rye, barley, rice and maize. They are apparently most uumerous in maize and a number of characters which affect the color of the endosperm or aleurone layer and the texture of the endosperm tissue of this species have long been familiar, and have played an important part in the researches leading up to the re-discovery of Mendel's Law

* Parts I-IV of a thesis submitted to the Faculty of the Bussey Institution of Harvard University in partial fulfillment of the requirements for the degree of Doctor of Science, June, 1925. Part V, on "Genetic Factors Which Affect the Development of the Gametophyte and Their Relation to Some Endosperm Characters," has been combined with researches by Dr. D. F. Jones on the same subject and will appear in Genetics, Vol. XI, under the title "The Expression of Mendelian Factors in the Gametophyte of Maize."

in 1900 and in the accumulation of a vast amount of genetic evidence since its re-discovery.

The endosperm characters of maize are of unusual value to the geneticist because, like all endosperm characters, they are visible sooner than those which affect other parts of the plant, and because they are readily studied in large numbers without the necessity of devoting a great amount of land or labor to the purpose. The average ear of maize bears from several hundred to a thousand seeds and one pollination on a single plant produces a large population which is readily classified because the environment has been remarkably alike for all its members.

In recent years the widespread application of a new method of corn improvement which involves the extensive inbreeding of this crop by artificial self-pollination, has brought to light many new characters which influence the development of the endosperm. Because of their possible phylogenetic significance, and because they represent new material which may prove of value in charting the germplasm of this important species, these characters merit a thorough study. The following pages are devoted to the preliminary investigations of a number of these new characters, their breeding behavior, morphology, effect upon development, and their relation to each other and to other characters.

DEFINITIONS

Two terms are used so frequently throughout the pages which follow that they deserve to be defined and limited.

The *endosperm generation* is the period beginning with fertilization and ending with the disappearance of the endosperm through absorption or digestion. In the cereals, the endosperm persists until the germination of the seed but in some plants it is almost completely lost in the early stages of development. This period has also been termed the *xenia* generation by some writers. In crosses the F_2 endosperm generation is borne on F_1 plants.

An *endosperm character* is any character which has its expression in the endosperm generation. The term does not imply that the character in question affects only the endosperm, in fact some of the endosperm characters produce their major effect upon the embryo.

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PART I

Defective Seeds

Defective seeds are lethal or semi-lethal characters which affect the development of the endosperm and embryo between the time of fertilization and maturity. These characters were first reported by Jones (1920) who described them as "aborted seeds with either entirely empty pericarps or badly shrivelled seeds, completely lethal in some cases and partially so in others," He found these characters to be inherited as simple Mendelian recessives.

Previous to 1920 aborted seeds had frequently been noted on open-pollinated ears of maize but had generally been regarded as due to imperfect pollination or other external factors.

Self-pollinated ears in which approximately one fourth of the seeds were aborted, had also undoubtedly appeared in the cultures of many investigators before 1920 but these lethal characters were not noted or were not regarded as heritable.

In an early edition of Bailey's "Plant Breeding" appears a photograph of two ears grown shortly after the re-discovery of Mendel's Law, illustrating the alternative inheritance of the starchy and sugary conditions of the endosperm. One of these ears is clearly segregating for defective seeds in addition to the other two characters. The segregation is so well defined that the normal and aborted seeds on three of the rows of grain can be counted from the photograph. Seventy-five normal and 23 defective seeds are noted. The investigator who pollinated these ears to prove or disprove to his own satisfaction the newly re-discovered Law of Mendel, had more evidence of its correctness than he probably realized.

Richey (1923) found several defective seeds on an ear of maize, believed to be many centuries old, unearthed from an Indian graveyard in Peru. He concludes from this discovery that defective seeds are characters of considerable antiquity. Although his conclusion is probably correct, it is scarcely justified from this evidence alone, since it is equally possible that the few aborted seed on this ancient ear are of the non-hereditary types described in Part II.

In the past few years many experiment stations in this country, Canada, South America and Europe have undertaken projects for the improvement of corn by the method outlined by East and Jones (1919) and by Jones (1920) and known as "Selection in Self-fertilized Lines." Thousands of self-pollinations in many varieties have been made every year, and this extensive inbreeding of a naturally cross-fertilized species has brought to light many recessive variations previously covered up by the remarkable heterozygosity which exists in the average variety of maize.

Among these variations have been a large number of defective seed types.

The writer (Mangelsdorf, 1923) has noted defective seeds in self-pollinated ears of more than 30 representative American varieties as well as several from Spain, Italy, China and Peru. Since 1920, defective seeds have been reported under various names by numerous investigators. Lindstrom (1920, 1923) has described "abortive," "flint defectives," and "sweet defectives." Demerec (1923) has reported a condition which he calls "germless," Eyster (1922) a peculiar defect to which he gives the term

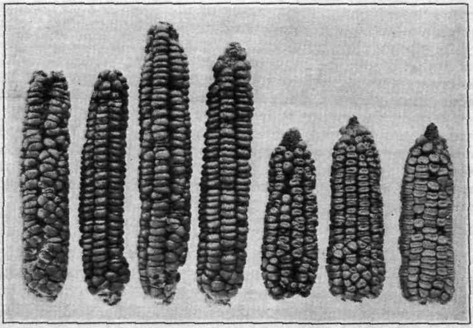

FIG. 51.—Self-pollinated ears of three New England varieties which are segregating for defective seeds. The third, sixth and seventh ears from the left represent the original ears of stocks de_1, de_3 and de_8 respectively.

"scarred" and Wentz (1924) a type known as "miniature germ." Garber and Wade (1924) report a semi-lethal type of defective seed in their cultures.

All of these characters may be considered as variations of the "defective" condition since all of them represent a seed development considerably below normal and most of them are lethal or semi-lethal in a homozygous condition.

WIDESPREAD DISTRIBUTION IN GERMPLASM

Some conception of the frequency with which defective seeds occur may be gained from the following figures taken from self-pollinations made in typical American varieties.

Defective seeds were first noted in a lot of 86 self-pollinated ears of four New England varieties. Thirteen of these ears, or 15.0 per cent, were segregating.

In 1922, 575 self-pollinated ears of six regional strains of Sanford White Flint were examined for these variations. Nineteen of these ears, or 3.3 per cent, were found to be segregating.

Hutchison (1922), in making a systematic search for variations of all sorts, self-pollinated 2,110 ears representing 468 different lots of seed which had been obtained from seed companies and experiment stations. These lots contained most of the varieties commonly grown in the Northern states and included sweet, pop, dent, and flint types. Sixty-seven of these ears, or 3.2 per cent, were found to be segregating for defective seeds.

The percentage of segregating ears, following the first self-pollination, in the lot of 575 ears of Sanford White, agrees so closely with the percentage found in Hutchison's 2,110 ears, that these figures, 3.3 and 3.2, probably represent the average condition of most varieties of maize. In other words, about one plant in every 30 in the average variety is heterozygous for a lethal factor which causes defective seeds. In some varieties this proportion is probably higher, depending to some extent on the amount of natural self-pollination which has occurred in past generations.

ORIGIN BY MUTATION

The relatively high frequency of these lethal characters in most varieties suggests that maize, like *Drosophila,* is constantly undergoing factor changes at various points in the germplasm and that a large proportion of these changes may be lethal in their effect. Muller and Altenburg (1919), in a study to determine the frequency of mutation in the X chromosome of *Drosophila,* find that characters which are lethal or semi-lethal are the most frequent to occur. They estimate that the X chromosome in *Drosophila* produces a new lethal, on the average, about once in every 100 generations. Recent evidence from homozygous inbred strains of maize indicates that the frequency of lethal mutations in this species may be as high or perhaps considerably higher.

In 1921 an inbred strain of maize which had been self-pollinated for thirteen generations and which was apparently homozygous for its genetic factors, as demonstrated by a test made by Jones (1924), began to segregate for defective seeds. The sudden appearance of this new character was clearly due to a germinal change since nothing of this kind had previously been noted, although a careful search for new variations in all inbred strains had been constantly maintained. Nor could this new character have been the result of a segregation following accidental crossing since outcrossing with unrelated stocks is immediately apparent

by the increased vigor and productiveness of the hybrid plants. With the exception of the segregation for defective seeds, the mutant stock differed in no detail from the original inbred strain.

This new character originating by mutation in a homozygous stock is a typical defective seed, is completely lethal in its effect

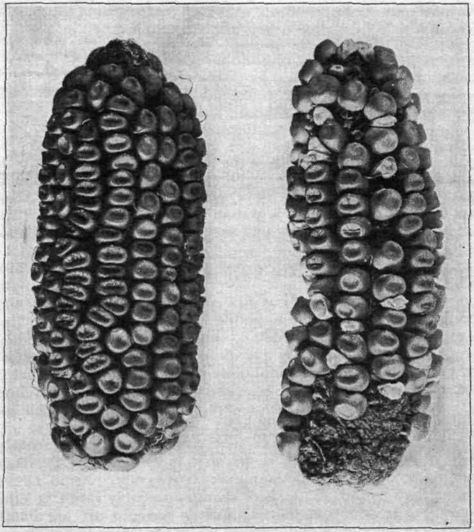

FIG. 52.—Ears of a strain of Leaming which mutated to defective seeds after thirteen generations of inbreeding. The ear at the right is segregating for the mutant character.

and is inherited as a simple Mendelian recessive. Ears of this inbred strain which are segregating for defective seeds are shown in Fig. 52.

A sister strain separated from this one after seven generations of inbreeding also showed defective seeds in the thirteenth generation when grown by H. A. Wallace at Des Moines, Iowa. This

same strain, though of slightly different pedigree, produced defective seeds on two ears in 1924 after 17 generations of inbreeding. The parental ears of both segregating progenies were normal in 1923 so two separate mutations must have occurred. In other words, four separate mutations have appeared in the germplasm of this strain in the past four years and each time a lethal character, defective seeds, resulted. The pedigree, showing the generations in which the mutations were first noted, is given below:

1-6-1-3-4-4-4-2 < 4-4-2-1 < 1-1-1-1-1-1 < (1) seg. de.
                                                                  (2) seg. de.
                                    3-(1) seg. de.
                      5-5-2-1-1-(1) seg. de.

The two defectives which were noted in 1924 are similar in appearance but both are quite different from the one found in 1921. Though no crosses have yet been made between these four separate mutations, it is certain that they are of at least two distinct types phenotypically and probably genetic differences will be found as well.

In the past four years only a few ears have been self-pollinated each season from this strain. The fact that four separate mutations have been noted in this rather small sample indicates that germinal changes are now occurring rather frequently. Previous to 1921, however, no mutations in this stock had ever been noted, though an active search for variations was constantly maintained and in some seasons a large number of ears were self-pollinated. The only other mutations ever found in inbred strains have been red cobs in a white cob strain, dwarf plants in another strain and a chlorophyll deficiency in a third.

From the limited experience with these long-inbred and relatively homozygous strains of maize it is evident that germinal changes do occur and, perhaps, very frequently. As in *Drosophila*, a high proportion of these changes probably result in lethal factors. The dominant lethals, if they occur at all, are immediately lost, because individuals which carry them do not live to reproduce. The recessive factors, unless they have a marked deleterious effect in the heterozygous condition, may be carried along for generations. It is not at all surprising, therefore, to find these lethal factors in almost every variety of maize. Inbreeding brings them to light and demonstrates that about one plant in every thirty is heterozygous for one or more of them. How many genetically distinct lethal seed factors there are in maize can not be estimated at the present time, but some indication of the enormous number which probably exists may be gained from the following pages.

SOURCE OF MATERIAL

As already mentioned, defective seeds were noted by the writer in more than 30 varieties of maize. It soon became evident, that in order to make a thorough investigation it would be impossible to study the breeding behavior of more than half this number. Accordingly only those stocks in which defective seeds had appeared at least two successive generations, and in which the segregating ears gave clear-cut 3:1 ratios, were continued. Fourteen stocks met these requirements and were retained.

It is almost certain that, in confining the investigation to those strains in which simple 3:1 ratios were obtained, lethals which are due to duplicate or triplicate factors were eliminated. It was considered best, however, to study first the inheritance of the simple recessives without the complications brought in by duplicate or triplicate factors, especially since defectives which segregate in 15:1 or 63:1 ratios would be difficult to distinguish from the various types of non-hereditary defectives which occur in small numbers on almost every ear and which are discussed in some detail in Part II.

The source of the fourteen types of defective seeds used in this investigation is given below. The *de* numbers under which they are discussed were assigned after all the types had been arranged in a series on the basis of their "defectiveness." Those with high numbers such as de_{13} and de_{14} are the most defective in appearance, while those with low numbers, such as de_1, de_2, and de_3 most nearly approach the normal condition and are only semi-lethal in effect, being sometimes obtained in a homozygous condition.

de_1

This type appeared following the first self-pollination of Gold Nugget, an eight rowed, large-eared, yellow, flint variety. Twenty self-pollinated ears were obtained of which three were segregating for defective seeds. Only one strain has been kept heterozygous for defective seeds.

de_2

This defective was obtained from a self-pollinated ear of an eight-rowed yellow flint type grown by Dr. E. G. Anderson, then at Cornell University. This is probably the same stock in which Lindstrom found his "flint defective" and, if so, was obtained originally from Dr. W. E. Castle of Harvard University.

de_3

Defective seeds appeared on a self-pollinated ear of Century Dent, a many-rowed, medium early, yellow, New England dent variety. Five ears out of 18 which were self-pollinated, segre-

gated for defective seed, but only this and one other, de_8, have been continued.

de_4

This type was first noted in the third generation of inbreeding in two ears of a strain of Beardsley's Leaming, a many-rowed, fairly late, yellow dent variety. No defectives had been noted in this strain in the first two generations and their appearance in the third may have been due to mutation.

de_5

This stock originated from a segregating self-pollinated ear of Reid's Yellow Dent received from Dr. J. R. Holbert of Bloomington, Illinois.

de_6

A self-pollinated ear of Luce's Favorite, a large eared, New England dent variety received from Dr. R. A. Emerson, segregated for defective seeds of this type.

de_7

A mutation in an inbred strain of Chester's Leaming which had been self-pollinated for thirteen successive generations and was apparently homozygous, gave rise to this defective.

de_8

This stock originated from another ear of the same lot of self-pollinated ears of Century Dent as de_3.

de_9

This type was found on a self-pollinated ear of Cornell No. 12, a selection of Funk's 90 Day, obtained from Dr. R. A. Emerson.

de_{10}

This defective appeared in a stock of "fine striped" which had been obtained some years previously from Cornell University.

de_{11}

The source of this stock was a self-pollinated ear of Clarage Dent, a typical Western yellow dent variety received from Professor M. T. Meyers, Ohio University.

de_{12}

Seeds of this type appeared in a self-pollinated ear of Burbank's "Rainbow," a novelty purchased from Peter Henderson Co., New York.

de_{13}

This type was isolated from a cross made by Mr. H. A. Wallace of Des Moines, Iowa. The seed parent was a hybrid combination of four inbred strains; the pollen parent a plant of "Illinois Two Ear" which Mr. Wallace believed to be homozygous for defective seeds.

de_{14}

This defective appeared in the second generation of inbreeding of a strain of Beardsley's Leaming, the same variety which gave rise to de_4. Defective seeds were not noted in this strain in the first generation of inbreeding.

SIMPLE MENDELIAN RECESSIVES

Except for the fact that there is often a slight deficiency of recessives, whereas an excess might be expected because of the regular occurrence of non-hereditary defectives on almost every ear, all of these fourteen types appear to be inherited as simple Mendelian recessives.

CROSSING EXPERIMENTS

The first defectives studied, de_1, de_2, de_3, and de_8, showed slight phenotypical differences, the first three being "partial" defectives; the last a "complete" defective. Crosses of these four strains made by Dr. D. F. Jones, the later generations of which were classified by the writer, indicated that these four defectives were genetically distinct. The next step was to determine the number of factors involved in the remaining ten stocks.

METHOD OF CROSSING

Throughout the investigation the general method of crossing two stocks has been as follows: A number of tassels, five or more, of the strain to be used as pollen parent were bagged. When pollinations were made the pollen from all of the bagged plants was collected, combined and mixed. Theoretically two-thirds of the plants in any segregating stock are heterozygous for the lethal factor and one-third are homozygous for the dominant allelomorph. Half of the pollen grains of the heterozygous plants should carry the lethal factor while the remaining half, as well as all of the pollen from the homozygous plants, should lack the lethal factor. Assuming an equal production of pollen by the heterozygous and homozygous plants, a composite collection of pollen made in this way should contain, on the average, one-third of the pollen grains carrying the lethal factor and two-thirds carrying its dominant allelomorph.

The seed parent of the cross should, like the pollen parent, produce heterozygous and homozygous plants in the proportion of 2:1. When the composite mixture of pollen is applied to homozygous plants, only normal seeds should be produced. When applied to the heterozygous plants, of which half the ovules carry the lethal factor, one-sixth of the seeds should be defective if the two stocks which are crossed are alike in their lethal factors, but all of the seeds should be normal if the lethal factors of the two parental stocks are unlike.

Since on the average two-thirds of the plants of a segregating stock are heterozygous for the lethal factor, the odds against obtaining no heterozygous plants when pollinations are made by this method are as follows:

No. Ears Pollinated	*Odds*
1	2:1
2	8:1
3	26:1
4	80:1
5	242:1

In order to be reasonably certain of including at least one heterozygous plant in every cross and to allow for failure to secure seed, it was customary to pollinate five ears. The pollen was always collected from five or more plants and it is practically certain that some pollen from heterozygons plants was always included in the mixtures.

This method of making the crosses between stocks, rather than between individual plants, has the advantage of being very rapid, a large number of pollinations being made from a single collection of pollen.

In several cases in which crosses were made between strains which regularly bear two ears, one of the ears was self-fertilized to determine the composition of the plant, the other was crossed. At harvest, only the crosses between known heterozygotes were retained. This method requires so much additional time and labor that its possible advantages are offset by the fact that only a limited number of crosses can be made in a season. The same objections were found to the method used by Demerec (1923) who, in making crosses between white seedling stocks, pollinated the ears with a mixture of own and foreign pollen and separated the selfed and crossed seeds by the effects of xenia. Only stocks which differ in their endosperm color or texture can be crossed by this method.

That the method of crossing at random without determining the composition of the plants used, gives the results which are theoretically expected, is shown by the following experiment, which incidentally shows that these lethal factors retain their genetic

identity as do any other Mendelian characters. A stock in which defective seeds had appeared for three successive generations was crossed with another stock originally from the same source, but which had been crossed with an entirely unrelated strain and the defective seeds recovered in the second generation. The pedigree of these two stocks is shown below:

$$105\text{-}9\text{-}7 < \begin{matrix} 1\text{-}1 = \text{Stock A} \\ \text{Cross-}9\text{-}1 = \text{Stock B} \end{matrix}$$

Six ears of Stock A were pollinated by a mixture of pollen collected from six plants of B. Four of the six ears proved to be segregating for defective seeds. A count of the normal and defective seeds on these four segregating ears is shown in Table 1.

TABLE 1. Ratios Resulting when Plants Heterozygous for a Lethal Factor are Pollinated with a Composite Mixture of Pollen from *Homozygous* and Heterozygous Plants.

Ear No.	Normal	Defective
448	184	22
449	116	32
450	151	32
451	164	43
Total	615	129
Ex. 5:1	620	124
Deviation	5	

The agreement of the actual results with the theoretical expectation is surprisingly good. Exactly two-thirds of the ears proved to be segregating and exactly one-sixth of the seeds on these ears were defective.

RESULTS OF CROSSES

It was believed that the most rapid progress in determining the total number of lethals involved in the fourteen stocks, would be made by crossing the first four, which were apparently all different, with the remaining ten, on the assumption that some of the untested stocks would prove to be carrying the same lethal factors as the first four and these could then be eliminated from further investigation.

Thirty-nine crosses were made in 1922 with the astonishing results that the F_1 seeds were normal in every case. This indicated that not one of the ten stocks carried the same genetic factors for defective seeds as the four original strains by which they had been crossed,

The next step was to cross the stocks in all combinations among themselves. This program involved a total of 91 crosses $\frac{n^2-n}{2}$ of which 45 had already been made. Since the remainder could not all be made in a single season, it was decided to cross first only the stocks in which the defective seeds showed some resemblance. In appearance the fourteen types range from complete defectives in which the caryopsis consists of little more than the flattened, transparent, pericarp to the partial defectives in which the recessive seeds are about half the size of normal seeds. Between these two extremes are all gradations and within each type there is a certain amount of variation. Several representative types of defectives are shown in Fig. 53. The fourteen types were arranged in a series on the basis of the average appearance of the recessive seeds. The plan was to cross each type with the two or three others nearest to it in the series. Although it was realized that resemblance in appearance did not necessarily mean genetic relationship, it seemed only reasonable to suppose that types resembling each other phenotypically were more likely to be alike genetically than those which were wholly different in appearance.

Twenty-seven crosses between types close together in the series were made in 1923 and again every cross produced only normal seeds.

Four additional crosses were made in 1924 and eight more in 1925; these, with the six preliminary crosses of 1920 and 1921, bring the total number to 84. Two of the crosses were reciprocals, however, so that the actual number of distinct combinations is only 82. This leaves 9 of the possible 91 crosses which are not yet made.

Of all these crosses, only one, a combination of de_5 and de_{11}, gave defective seeds in F_1. This shows that de_5 and de_{11} are genetically identical, and that the results of any crosses made with one of these stocks applies as well to the other. Taking this fact into consideration only seven combinations remain to be made.

THE F_2 GENERATION

In order to be certain that segregating plants had always been included in making the crosses, and to obtain additional evidence that the two types entering the cross were genetically distinct in each case, F_2 progenies of a large proportion of the crosses have been grown.

Since the heterozygous crossed ears could not be distinguished from the homozygous ones, all of the ears of a cross were combined by counting off an equal number of seeds from each. As

one-third of the pollen grains of a composite collection of pollen are expected to carry the lethal factor of the pollen parent, and

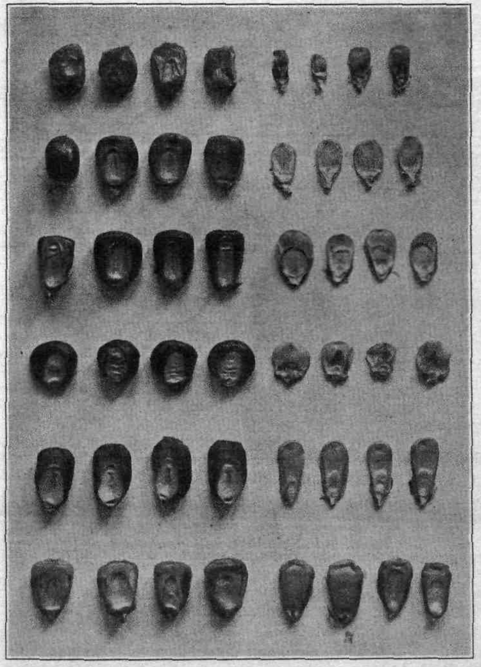

FIG. 53.—Six types of defective seeds showing the gradation from complete to partial defectives. Normal seeds from same ears are shown at left.

one-third of the ovules on a composite collection of ears the lethal factor of the seed parent, then a mixture of seed obtained from

such crosses would be expected to give on the average the following F_2 progenies:

4 Ears not segregating.
2 Ears segregating for defective of pollen parent.
2 Ears segregating for defective of seed parent.
1 Ear segregating for both defectives.

The di-hybrid ears are expected only once in nine times. However, if the defectives contributed by the two parents show slight phenotypical difference, then the reappearance of two distinct types in F_2 may be regarded as fairly conclusive evidence that heterozygous plants of both parents were included in making the cross and that the parental types are therefore genetically unlike.

In order to have better than an even chance of obtaining di-hybrid ears, it was customary to self-pollinate fifteen to twenty plants of each cross. Though this method of making crosses in a wholesale manner and self-pollinating F_2 progenies on the same prodigious scale, may appear to entail unnecessary labor, in reality, it proved to be the most economical procedure. It is true that by growing only the crosses between plants known to be heterozygous, di-hybrid ears would be expected once out of every four trials instead of once in every nine. Self-pollinating vigorous F_1 plants on a large scale can be done very rapidly, however, and it has been found easier to make the crosses at random and pollinate twice as many F_2 progenies, than to make individual crosses between numbered plants and self-pollinate fewer F_2 progenies.

A total of 1089 F_2 progenies of crosses made by this method have been self-pollinated. The ratio of non-segregating to mono-hybrid and di-hybrid ears is given in Table 2.

TABLE 2. Non-segregating, Mono-hybrid, and Di-hybrid Progenies Obtained in F_2 from Crosses Made at Random.

	Found	*Expected*	*Deviation*
Ears not segregating	428	484	—56
Ears segregating one type	552	484	68
Ears segregating both types	109	121	—12

The number of dy-hybrid ears obtained agrees very closely with the theoretical expectation. There is a significant excess of the mono-hybrid ears, however. These are expected only as frequently as the non-segregating ears, actually they have appeared in considerable excess. A greater production of pollen by the heterozygous plants in some of the stocks, or the occurrence of heterozygous plants more frequently than two out of three, might account for this.

SUMMARY OF CROSSES

The diagram in Fig. 54 gives a picture of the situation with respect to these fourteen stocks.* Squares with vertical cross hatching represent crosses in which the F_1 seeds were normal. Those with horizontal cross hatching represent crosses in which

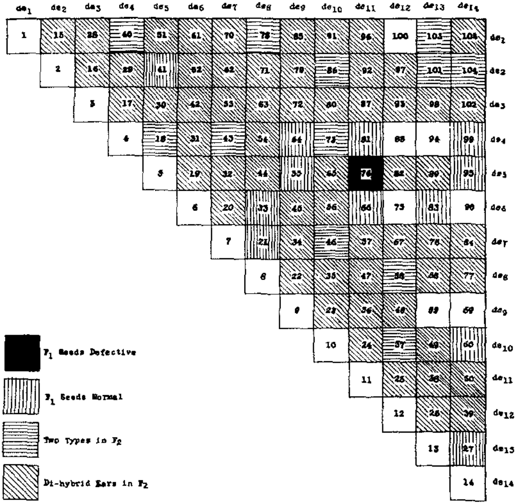

FIG. 54.—Diagram showing the crosses which have been made among the fourteen defective seed stocks. The types were arranged in the order of their "defectiveness."

the F_1 seeds were normal and two distinct types of defectives appeared in F_2 though no di-hybrid ears were obtained. Squares with diagonal cross hatching represent crosses in which the F_1

* For reasons of economy the detailed data showing the segregation in the individual ears of the fourteen parental stocks and their crosses are not included. Any marked deviations from expectation are noted, however, and are discussed in this and other papers.

seeds were normal and one or more di-hybrid ears were obtained in F_2, while the single case in which defective seeds appeared in F_1 is shown by a solid square.

As has already been pointed out, the production of only normal seeds in F_1 is fairly good evidence that the two types entering the cross are genetically distinct providing that three or more ears have been crossed. The reappearance of two distinct types in F_2 is still better evidence, while the occurrence of one or more di-hybrid ears may be safely regarded as conclusive proof.

The squares are numbered diagonally from top to bottom and from left to right. Thus 1-14 represent self-pollinations: 15-27 the crosses between types immediately adjacent in the series: 28-39 crosses between types one degree apart in the series and 40-50 crosses between types two steps apart. In other words the crosses 15-50 represent the most important combinations. It will be noted that all of these 36 crosses have been made. In 27 of these combinations di-hybrid ears have been obtained in F_2. In five crosses, Nos. 18, 37, 40, 43, and 46, two distinct types of defectives reappeared in F_2, while three of the combinations, Nos. 21, 33 and 41, have not been tested further than F_1. Since de_5 and de_{11} have proven to be identical, the crosses 24 and 38 represent the same combinations as 65 and 89. This leaves only 7 distinct combinations which have not yet been made. There is, however, some additional evidence in several of the untested combinations which indicates that the defectives involved are not alike. Crosses 88 and 94, representing combinations of de_4 by de_{12} and de_{13} respectively, will certainly give di-hybrid segregation in F_2 because de_4 is a "germless" defective while de_{12} and de_{13} both produce embryos. Crosses 75 and 90, representing combinations of de_6 by de_{12} and de_{14} respectively, should also give de-hybrid segregation because de_6 is linked with sugary, as recorded later, while de_{12} and de_{14} are not. The same is true of the cross 100 between de_1 and de_{12}. The former is linked with sugary, the latter not. This leaves only two combinations, 59 and 69, about which there is any doubt.

The evidence, then, is almost conclusive in indicating that thirteen distinct genetic factors for defective seeds are involved in the fourteen stocks tested. There is, of course, the possiblity that one of the two doubtful combinations will reveal an additional case of two stocks which are genetically identical, even though these combinations are between defectives which differ decidedly in appearance. It must be remembered that two characters may be genetically identical in one main factor and yet differ phenotypically because of minor modifying factors. This is shown by the cross between de_5 and de_{11} which proved these two defectives to be identical although they were far apart in the arbitrary series which had been arranged on the basis of external appearance.

These results give some indication of the enormous number of distinct defective seed types which probably occur in maize. A sample of fourteen types was taken at random from the grab bag which constitutes the germplasm of maize, and thirteen of these proved to be genetically distinct. The total number of distinct lethal seed factors in the germplasm of this species can only be conjectured, but it probably equals or exceeds the number of distinct varieties of maize which are now grown.

THE MORPHOLOGY OF DEFECTIVE SEEDS

In order to determine the irregularities in development which cause one-fourth of the seeds on a segregating ear to be defective while the remainder are normal, and to find, if possible, constant differences which distinguish some of the types from others, a histological examination of all fourteen types, in various stages of development, has been made.

The material was killed and fixed in Carnoy's solution, a mixture of three parts of absolute alcohol to one of glacial acetic acid. Two other fixing agents, Benda's solution and a concentrated solution of picric acid, were also tried. The former gave excellent results, but was discontinued because of the high cost of osmic acid, its most important constituent. The picric acid solution proved to be very unsatisfactory because of the difficulty of removing all traces of the discoloration from such large sections. All material was imbedded in paraffin, cut in sections of ten microns and stained in Delafield's haematoxylin. Some of the sections were also stained in a dilute solution of iodine and potassium iodide to bring out possible differences in the starch grains.

THE CYTOLOGICAL MECHANISM OF ENDOSPERM FORMATION

The cytological details of the mechanism leading up to the formation of the endosperm in maize are fairly well established. When Nawaschin, in 1898, made the discovery that the endosperm of *Lilium* is the product of a sexual fusion entirely apart from that which gives rise to the embryo, three investigators, DeVries (1899), Correns (1899), and Webber (1900), simultaneously and independently reached the conclusion that this mechanism was probably responsible for the phenomenon of xenia in maize, although it was not until 1901 that Guignard furnished the cytological evidence of double fertilization in this species.

More recently Weatherwax (1919) and Miller (1919) have independently repeated Guignard's researches and both have given detailed descriptions and illustrations of the entire process leading up to fertilization. In most respects the accounts of these two writers agree very well, though Miller believed that all four

megaspores functioned while Weatherwax observed the disintegration of three megaspores, with only one persisting. In an earlier paper, however, Weatherwax (1917) also had made the observation that all four megaspores functioned and his discovery that only one persisted was made only after attention was called to the disagreement between his earlier cytological observation and certain well established facts regarding the genetic behavior of the endosperm.

When the pollen tube enters the micropyle, two identical sperm are emptied into the embryo sac. One of these fuses with the egg and an embryo is produced; the other fuses with one of the polar nuclei which lie close together in the embryo sac. Almost immediately the fusing nuclei are joined by the second polar nucleus, this process constituting the "triple fusion" characteristic of many angiosperms. It is of importance to note, in connection with the possible explanation of some of the forms of non-hereditary defectives described later, that both Weatherwax and Miller, in repeated observations, never found the two polar nuclei fusing before fertilization of one of them had occurred.

The endosperm of angiosperms is uniqne in that it is the product of a fusion in which the two parents do not contribute equally. Two maternal nuclei, with their assortment of chromosomes bearing the hereditary factors, combine with one male nucleus. The female parent, therefore, contributes two sets of chromosomes and a double dose of the assortment of hereditary factors while the pollen parent contributes only one set of chromosomes and a single dose of factors.

This peculiar situation enabled Hayes and East (1915) to demonstrate the fallacy of the "presence and absence" conception of dominant and recessive factors. These writers found that in crosses between flint and flour varieties the inheritance was always apparently maternal, a double dose of the maternal condition being always dominant to a single dose of the alternative condition. In other words, two "absences" were dominant to a single "presence."

DEVELOPMENT AFTER FERTILIZATION

The general features of the development of the endosperm and embryo in the cereals are fairly well established. Details of development which distinguish maize from other grasses are gradually being added as special phases are investigated. True (1893) and Poindexter (1903) studied the general development of the caryopsis. Reed (1904) has investigated the secreting cells of the scutellum of maize. Sargent and Robertson (1905) have made a very thorough study of the anatomy of the scutellum. The aleurone layer has been the subject of cytological studies especially by Lüdtke (1890), Haberlandt (1890) and Groom

(1893). The successive stages in the development of the embryo have been described and figured by Weatherwax (1920).

The general development of the caryopsis in maize is briefly as follows: The endosperm fusion nucleus begins division almost at once and the rapidly growing endosperm soon fills the embryo sac. The embryo nucleus does not divide immediately after fusion and the first division usually does not occur until after the nuclei of the endosperm number 20 or more. (Miller, 1919.) The nucellus soon begins to disintegrate and is partly absorbed, the remainder being compressed into a thin integument between the pericarp and endosperm.

By the time that the early milk stage is reached, the endosperm occupies the entire space within the pericarp and exerts considerable pressure. (See Plate XXI, Fig. 1.) The embryo on the other hand is still rather rudimentary. Fom this point on, the embryo develops more rapidly than the endosperm, the latter undergoing only slight additional increase in size while the former grows rapidly, pushing further and further into the endosperm tissue.

Small starch grains are found in the outer cells of the endosperm in the early milk stage, which in the writer's material occurred at about 15-20 days after pollination. By the time that the late milk stage is reached at about 25 days to four weeks after pollination, the cells in the upper part of the endosperm are completely packed with starch grains, although those in the lower part are still relatively clear. In material fixed after this stage, the contents of the cells drop out in sectioning and in most cases no histological studies of further changes have been made.

The aleurone layer is present in most specimens in the early milk stage, though no color can be detected in this layer in unsectioned material at this period.

DEVELOPMENT OF DEFECTIVE SEEDS

In preliminary experiments of 1922, seeds were fixed at intervals of 1, 2, 4, 7, 10, 20 and 30 days after pollination. The defective seeds could not be distinguished from the normal seeds in the early stages and it was necessary to examine sections from a large number of seeds in order to be certain that defectives were included. In 1923 no material was collected until the normals and defectives on segregating ears could be distinguished from each other. This point was usually reached in the blister or early milk stage, or at about fifteen to twenty days after pollination in most of the types. Some of the partial defectives, however, could not be distinguished from normal seeds on the same ears until later.

Defectives and normal seeds were always removed in pairs for comparison and the seeds were usually taken from the middle of

the ear to avoid differences due to unequal development at butts and tips of the ears. Before dropping the seeds into the fixing agent, as much tissue as possible on either side of the embryo was removed to permit a more rapid penetration of the solution.

REGULAR DEVELOPMENT IN EARLY STAGES

The inheritance of all of the defective seed types as simple Mendelian recessives pointed to a regular functioning of the fertilization mechanism and the fusion of male and female gametes. The specimens collected in the early stages bore out this assumption. All of the types of which the early stages after pollination were studied showed the normal beginning of endosperm and embryo formation and no marked differences between normal and defective seeds were noted.

In specimens fixed after the blister or early milk stage, however, the differences between normal and defective seeds were very striking. The various types of defectives differed from each other, however, only in general development and, with the exception of one type, no specific morphological differences, which always distinguish one type from another, have been found. A general account of the development of these various types of aborted seeds follows.

THE PERICARP

No matter how defective the endosperm and embryo may be, the pericarp usually attains a normal or almost normal development. This affords a striking illustration of the complete independence of these two tissues which, though borne on the same plant, represent distinct sporophyte generations. The pericarp is maternal in its origin and with the exception of the stimulus from pollination which sets off its development, it does not appear to be influenced by the hereditary composition of the new sporophyte which it encloses.

In normal seeds, the pericarp is constantly distended by the pressure of the growing endosperm. In the defectives, there is always a space between these tissues. In early stages this space is filled, partly with nucellar tissue and partly with a clear watery solution. In later stages the walls of the ovule are pushed together by the pressure of the normal seeds on either side and the space disappears as shown in Plate XXI, which shows three successive stages in the development of the de_{14} type of defective seeds.

THE NUCELLUS

In normal seeds the nucellus rapidly disintegrates following fertilization. Part of it is probably absorbed while the remainder is compressed into a thin integument between the endosperm and

final size is considerably less than that of a normal endosperm. (Plate XXII.)

The order of the fourteen stocks of defective seeds on the basis of their endosperm development as shown by these histological studies is not exactly the same as the arrangement made on the basis of external appearance alone. In general, however, the two series agree very well.

STARCH GRAIN FORMATION

The same general differences noted in size of endosperm are also found with regard to the formation of the starch grains. In the defectives at the lower end of the series no starch grains were found at any stage examined. Types further up in the series produce small starch grains in the periphery of the endosperm in later stages, while in the partial defectives, starch grains are found

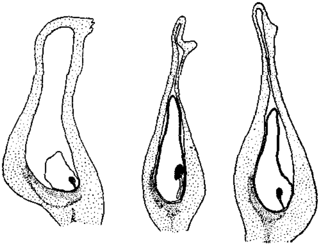

Fig. 56.—Defective seeds of de_{14} at early milk stage; de_7, late milk; de_{12}, late milk.

in every stage examined, and in later stages the cells of the endosperm are packed with starch grains which are apparently normal in size and structure.

No characteristic differences in the structure of starch grains were noted with the exception of the defective seeds of de_4. In the recessive seeds of this strain the starch grains have the appearance of undergoing hydrolosis many of them being completely broken up.

THE ALEURONE LAYER

The defectives at the foot of the series produce no aleurone layer at any stage examined and this might be expected since an aleurone layer is usually formed only in later stages of normal development. Beginning with de_{11}, however, an aleurone layer

is found in the later stages examined. In some cases this layer extends only part way around the endosperm, in others it completely surrounds this structure except, of course, at the base where no aleurone layer is found even in normal seeds. Drawings in which the aleurone layer has been enlarged out of proportion to the other structures are shown in figures 55-58. In defectives higher in the series than de_{10}, an aleurone layer is found in almost all stages examined.

THE EMBRYO

With the exception of de_4 all of the types were found to contain embryos. This type is similar to the "germless" seeds reported by Demerec (1923) which at maturity contain no embryo.

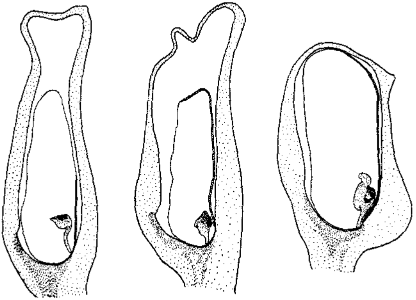

FIG. 57.—Defective seeds of de_{11} de_5 and de_6 at approximately the same stage, showing difference in degree of development of embryo, endosperm, and aleurone layer.

No paraffin sections of this defective were secured because the recessive seeds are distinguishable from the normals only shortly before maturity, at which time the seeds are too corneous to be sectioned by the paraffin method. Free-hand dissection in early stages of seeds from ears later proven to be segregating for this character, showed that an embryo was present in all the seeds. Apparently the embryo is digested and absorbed later. The cavity which remains on the germinal side of the seed is partly filled with a hard brittle mass of substance with no definite structure. As already mentioned, the endosperm of this type also shows evidence of digestion.

In general, there is a marked correlation between the development of the embryo and that of the endosperm. The complete defectives in which the endosperm remains practically stationary have very rudimentary, undifferentiated embryos which show no further development after the early milk stage. (Plate XXI.) Defectives higher in the series show some increase in size from week to week, but no clear differentiation of various parts of the embryo is apparent though a "growing point" is indicated by a greater concentration of nuclei in certain regions. Beginning with de_8, a scutellum, coleptile and several rudimentary leaves are distinguished, while in some of the partial defectives the development of the embryo is fairly normal.

The embryos of the defective seeds often show considerable distortion in shape. In later stages this may be attributed to the pressure exerted by the normal seeds on either side as shown in Plate XXIII, but in some cases a distortion is noted even when the defective seeds have not been under pressure. The embryo tends to be short and "blocky" as shown in Plate XXII, which may be compared to Plate XXIV which shows the successive stages in the development of the normal embryo.

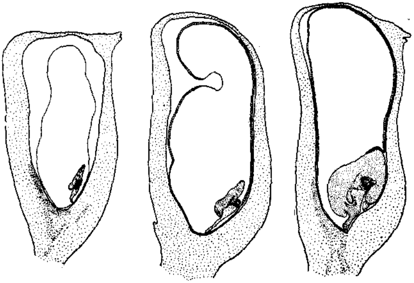

FIG. 58.—Three successive stages of de_8. No aleurone layer is found in the early stage but a partial or complete layer is formed later. Note the distortion of the embryo in the final stage.

GENERAL ASPECTS

Aside from the interesting demonstration that the pericarp, once its development is stimulated by pollination, proceeds quite independently of the tissues which it encloses, the most outstanding

feature of the morphology of the defective seeds is the marked correlation between the development of the endosperm and embryo.

An external examination of some of the defective seeds had led to the assumption that these, in many cases, contained no tissue whatever. It was surprising, therefore, to find distinct, though rudimentary, endosperm and embryo at some stage in every type examined. It was even more surprising to find that the deleterious influence of the lethal factors, which they carried, affected both of these structures to almost the same degree. It might be supposed that some factors would affect specifically the embryo, permitting the endosperm to continue in a more or less normal fashion. Others might be expected to inhibit particularly the endosperm. This has not been found to be the case. Even in the de_4 type, which lacks an embryo at maturity, the development of both structures proceeds normally in the early stages and the influence which later destroys the embryo also has a very marked effect upon the endosperm.

Although there is still some difference of opinion among morphologists as to the real nature of the endosperm in angiosperms, from the standpoint of the geneticist it has always been considered a sporophyte, differing from its near relative the embryo, in structure, in capacity for continued development, and in ability to reproduce. In the expression of the hereditary factors which they receive, the endosperm and embryo are fundamentally alike and eventually the morphologists, too, may come to regard the endosperm of angiosperms as a modified sporophyte.

TABLE 3. Average Weight of Seeds from Ears Harvested at Successive Stages of Maturity.

Days after Pollination	Av. wt. in mg. 1	2	3	Av.	Relative Development
14	5	5	5	5	1.5
21	25	27	37	30	9.1
28	82	86	71	80	24.2
35	111	97	126	111	33.6
41	159	166	189	171	51.8
51	234	222	226	227	68.8
75	374	319	306	330	100.0

PHYSIOLOGY OF DEFECTIVE SEEDS

Histological examinations of the normal and defective seeds were confined largely to a rather brief period beginning with the blister stage and ending when the seeds had reached the dough stage. In order to determine the differences between normal and defective seeds in later stages of development, a comparison of their rate of growth, final dry weight, percentage of germination

and effect upon the sporophyte and gametophyte in the haploid condition was made.

RATE OF GROWTH, FINAL WEIGHT AND GERMINATION OF NORMAL SEEDS

The rate of growth of normal seeds of maize was determined as follows: A large number of plants of an F_1 hybrid of homozygous inbred strains were grown under uniform soil conditions. These plants, all being genetically alike, came into silk and were pollinated at about the same time. At two weeks after pollination, and at intervals thereafter until maturity, three ears were taken at random from these plants. The ears were reduced to an air dry condition after which the kernels were removed, counted, weighed "en masse" and the average weight at each stage determined by simple division.

It is qnite possible that in ears harvested at various stages of maturity in this way there is a transfer of materials from the cob to the kernels during the drying out process. Such an exchange, if it occurs at all, would probably be proportionate for the various stages and is not regarded as a serious source of error.

TABLE 4. Percentage Germination of Corn Seeds Harvested at Successive Stages of Maturity.

Days After Pollination	Relative Development	Percent Germination
14	1.5	0
21	9.1	28
28	24.2	56
35	33.6	72
41	51.8	92
51	68.8	96
75	100.0	98

The average weights in milligrams and the relative weights, as compared to the final weight at maturity, of these seeds harvested at various stages of development, are given in Table 3. Figures 1 and 2 of Plate XXV show respectively a representative ear at each stage and 50 seeds from each ear.

The 50 seeds representing each stage of development were planted in sand in the greenhouse with the results shown by the photograph in Plate XXV, Figure 3. Some germination occurred in every lot except the first which was harvested at fourteen days after pollination. The percentage of germination of each lot and the relative weight of the seeds from which it was grown are given in Table 4.

The normal seeds of maize, like those of barley (Harlan and Pope, 1922), are apparently capable of some germination at all stages of development but the very earliest.

RATE OF GROWTH, FINAL WEIGHT, AND GERMINATION OF DEFECTIVE SEEDS

The rate of growth of defective seeds as compared to normal seeds from the same ears was determined for one type, de_{10}. Ears from an F_1 hybrid of this stock crossed with an unrelated inbred strain were harvested when the segregation on the ears first became apparent and at intervals thereafter until maturity. When all the ears had been reduced to dryness, the kernels were shelled off, the normal and defective seeds separated, counted and weighed, and the average weight of each class determined. The growth curves of the normal and defective seeds from ears segregating for de_{10} are shown in Figure 59. Although the rate of

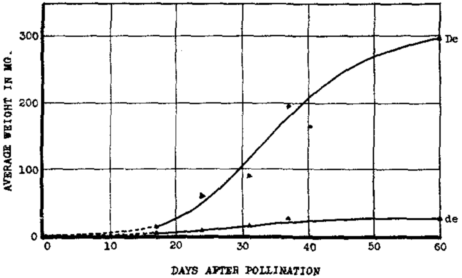

FIG. 59.—Growth curves of normal and defective seeds from the same segregating ears of the de_{10} stock.

increase in dry weight is very low for the defective seeds, the two curves appear to be of the same general type.

In determining the relative development at maturity of the fourteen types, dry weight was used as a criterion. Obviously, the relative development cannot be determined with any high degree of accuracy because it is influenced to some extent by the environment and considerably by the hereditary constitution of the stocks, certain of the types showing more development in crosses than in inbred strains. In order to make the determinations as nearly comparable as possible, the figures on relative development have, with one exception, been taken from crosses which were all identical with respect to one of the parents, and all grown the same season. In this way the defectives are compared under conditions in which hereditary and environmental differences are reduced to a minimum.

The relative development of defective seeds at maturity of each of the fourteen stocks is shown in Table 5.

TABLE 5. Relative Development in Defective Seeds of Fourteen Stocks as Compared to Normal Seeds on Same Ears.

Stock	No. Ears	Relative Development
de_1	6	50.4
de_2	3	58.8
de_3	3	29.9
de_4	3	37.3
de_5	2	18.0
de_6	3	34.0
de_7	3	18.8
de_8	3	15.0
de_9	3	5.9
de_{10}	2	13.7
de_{11}	3	7.3
de_{12}	3	4.0
de_{13}	2	4.5
de_{14}	3	2.4

The types show a range in development from 2.4 per cent in the de_{14} type to 58.8 in the de_2 type. It is noted that the order of these types based on their relative development is not the same as that arranged on the basis of external appearance alone. This is partly due to the fact that the original arrangement was based on inbred strains while the relative development has been determined from hybrids. Even when all are crossed with the same unrelated stock, some of the types, particularly 2, 7, and 10, show a greatly increased development after crossing. In some crosses the de_2 type reappears in the second generation so altered in appearance that it is scarcely recognized. The recessive seeds are almost equal to normal seeds in size and weight, and differ from the latter only in a paler color and a mottled appearance.

Whether this increase in development which follows crossing is due to the greater vigor of the plants on which they are borne, or to the action of modifying factors contributed by one or both parents, is not known. That some of the defectives are influenced by modifying factors, is almost certain. The de_5 and de_{11} types, for example, are genetically alike, yet differed in appearance, not only in the original stocks, but in hybrids in which both were crossed to the same unrelated stocks.

Judging from the dry weight alone, the fourteen types of defectives correspond to various stages in the development of the normal seed. This is shown diagramatically in Figure 73 (Part III) in which the relative development of each type is represented by a point on the normal growth curve of maize seeds.

At first glance, the defective seeds are comparable to normal seeds which have had their development arrested at an early stage,

as has occurred in the ears harvested at successive stages of development, shown in Plate XXV. When these various defective seeds are tested for germination, however, it is found that they are by no means equal to normal seeds of the same relative development. This is shown by the figures in Table 6, in which the germination of each type of defective is compared to the theoretical germination of immature normal seeds of the same relative development. The theoretical germination of the normal seeds was determined by interpolation of the figures in Table 4.

It is noted that the defective seeds in every case show a much lower germination than would be expected from normal seeds of

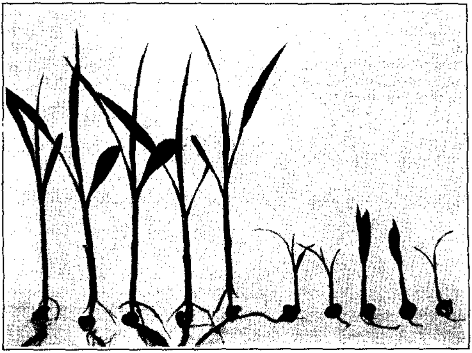

FIG. 60.—Seedlings from normal and defective seeds of de_2. Only rarely do the seedlings from the recessive seeds survive more than a few weeks.

similar development. In fact, the types below de_7 showed no germination whatever in this test with the exception of one seed from a total of 131 seeds of the de_{11} type. Defective seeds of de_8 have also shown slight germination in some cases, but in the ears used in this particular test no germination occurred.

Not only are the defective seeds less able to germinate than normal seeds of the same development, but those which do succeed in sprouting produce very weak seedlings which are lacking in vigor and soon die. Seedlings from normal and defective seeds of the de_2 stocks are shown in Figure 60. By planting large numbers of seeds in the greenhouse and transplanting the most

vigorous of the seedlings to the field, it has been possible to obtain homozygous plants of stocks 1, 2, 3 and 6.

The behavior of the plants grown from homozygous defectives is in striking contrast to those which result when immature normal seed is grown. In appearance the two lots of seed are almost identical, both being badly shrivelled and aborted. Both types give a low germination and the seedlings are, in both cases, very weak and spindling. The plants which are genetically normal, however, soon recover from the handicap of the poor food supply which the aborted seed affords, and by flowering time are fully normal in stature, and yield practically as much grain as plants which grow from well filled, mature seed. The homozygous defectives, on the other hand, remain very weak and spindling throughout the season, produce only a small amount of pollen, and rarely any ears. At least one pure defective ear has been obtained, however, from each of the four stocks mentioned above, during the past five seasons. Figure 61 shows a normal and pure defective ear from the de_8 stock.

TABLE 6. The Percentage of Germination in Defective Seeds of Fourteen Stocks Compared to the Theoretical Germination of Normal Seeds of the Same Relative Development.

Stock	Defectives	Theoretical Normal
de_1	45.6	91.0
de_2	44.9	94.0
de_3	54.0	66.5
de_4	3.5	75.5
de_5	11.2	47.5
de_6	11.8	72.5
de_7	19.6	49.0
de_8	0	42.0
de_9	0	17.0
de_{10}	0	39.0
de_{11}	0.8	22.0
de_{12}	0	10.0
de_{13}	0	12.5
de_{14}	0	3.5

The fact that the germination of the defective seeds is considerably lower than that of immature normal seeds of the same relative development, that the seedlings of all types are extremely weak, and that even the most vigorous ones which are able to survive make a very feeble growth throughout the season, indicates that these lethal and semi-lethal factors do more than merely arrest the seeds at a certain stage; apparently these factors in a homozygous condition have a deleterious influence on the sporophyte at any stage in which they are given an opportunity for expression. In most of the types the deleterious influence is so

marked that the career of the new sporophyte is brought to an end in the seed stage and the lethal factors have no opportunity for further damage past this period.

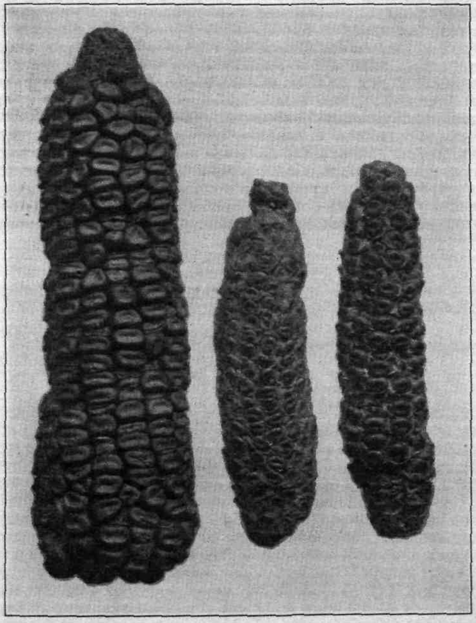

FIG. 61.—Left; ear segregating de_3. Center; self-pollinated ear from a plant homozygous for de_3. Right; open-pollinated ear from homozygous plant.

THE INFLUENCE OF LETHAL FACTORS IN HETEROZYGOUS CONDITION

Since the effect of the lethals is so marked when they are in homozygous condition, it might be questioned whether they have

not a similar unfavorable influence, though in a smaller degree, in the heterozygous condition.

The only evidence bearing on this question is that secured from a comparison of the height of segregating and non-segregating plants among the 1089 self-pollinated F_1 plants which were grown in 1923 and 1924. In 1923 the height to base of tassel on 398 F_1 plants was measured. The average heights of the plants which later proved to be free of these lethal factors was 77.9 inches as compared to 77.2 for those which segregated for a single type of defective and 73.7 for those which segregated for two types. In 1924, 659 F_1 plants were measured. The non-segregating plants averaged 73.9 inches in height as compared to 71.9 for the other two groups. Though the difference in height is not significant either year, the fact that the two groups of segregating plants are somewhat lower both years than the non-segregating plants may be of some significance. Table 7 gives the frequency distribution of the segregating and non-segregating plants for these two years.

Table 7. Frequency Distribution in Height of F_1 Plants from Crosses of Defective Seed Stocks.

Type of Plant	Mid-Class Values in Inches 42	47	52	57	62	67	72	77	82	87	92	97	102	Total	Mean
Segregating 3:1	3	7	9	22	51	72	86	117	98	52	12	2	..	531	73.85 ± .29
Segregating 9:7	..	..	1	6	9	15	23	20	17	9	..	..	..	100	73.30 ± .57
Total segregating plants	3	7	10	28	60	87	109	137	115	61	12	2	..	631	73.80 ± .36
Not segregating	..	5	8	21	29	45	78	89	69	54	15	2	1	416	74.90 ± .37
Difference in favor of non-segregating plants															1.10 ± .49

Although no data on the yield of segregating and non-segregating plants can be secured because the ears are artificially pollinated and full ears are seldom obtained, it has often been noted that the segregating ears have a tendency to be smaller than those which are uniformly normal.

These results and observations cannot be regarded as more than mere indications that the lethals do have an effect in the heterozygous condition; they certainly do not afford conclusive evidence in favor of such an assumption. The effect, if any, of the lethals when in combination with their dominant allelomorphs is so slight that it could be accurately detected only by a delicate test. Such a test is now being made with the inbred strains which have mutated to defective seeds, and which are presumably homozygous for all factors with the exception of a single pair involving the defective factor and its dominant allelomorph.

EFFECT UPON THE GAMETOPHYTE

The gametophyte generation is ordinarily assumed to be independent of the influences of the genetic factors distributed on the chromosomes which it carries. Recent evidence (Jones, 1924)

(Mangelsdorf and Jones, 1926) indicates, however, that there are exceptions to the rule and that in some cases, the gametophytes from the same plant are not all alike in their ability to reach the micropyle and accomplish fertilization. This brings up the question of the effect of the lethal factors on the gametophyte generation. Since these factors have such a marked deleterious influence on the sporophyte at all stages, might they not have some degree of expression in the gametophyte generation as well?

It has already been noted that there is a deficiency of recessive seeds on segregating ears of a number of these types and such a condition might be explained by slower rate of growth of the pollen tubes carrying the lethal factors.

In order to answer this question, a large number of segregating ears of the de_3 stock which regularly shows a deficiency of the recessives were divided arbitrarily into top and bottom halves and the normal and defective seeds in each half were counted separately. If there were a constant difference in the rate of growth between pollen tubes carrying the lethal factors and those carrying the dominant allelomorphs, then the greater difference which the pollen tubes were forced to travel in reaching the ovules at the base of the ears would act against those carrying the lethal factors and cause a greater deficiency of the defective seeds in the lower halves of the ears.

The results of making counts in the upper and lower half of fifteen cars segregating for de_3 are shown in Table 8.

TABLE 8. *Normal and Defective Seeds on Top and Bottom Halves of Ears Segregating de_3.*

Ear No.	Top Half Normal	Top Half Defective	Bottom Half Normal	Bottom Half Defective	Percent Defective Top	Percent Defective Bottom
10	165	60	204	50	26.7	19.7
29	146	48	158	48	24.7	23.3
30	154	44	145	39	22.2	21.2
33	89	24	78	36	21.2	31.6
45	190	57	207	54	23.1	20.7
46	210	63	200	65	23.1	24.5
51	156	44	178	36	22.0	16.8
55	155	45	185	55	22.5	22.9
56	138	40	172	60	22.5	25.9
58	145	56	171	50	27.9	22.6
120	119	32	144	48	21.2	25.0
135	119	32	79	31	21.2	28.2
139	145	47	96	31	24.5	24.4
148	125	41	145	42	24.7	22.5
158	115	46	112	41	28.6	26.8
Total	2171	679	2274	686	23.8	23.2
Ex 3:1	2137.5	712.5	2220	740		
Deviations	33.5		46			
P. E.	15.6		15.9			
Dev./P. E.	2.2		2.9			

Although the percentage of recessives in the bottom halves of these ears is lower than that in the top halves, the difference is not significant. When the ears are examined individually it is noted that the percentage of recessives is lower in the top half almost as frequently as in the bottom half.

From these results it may be concluded that the lethal factors have very little, if any, effect upon the rate of pollen tube growth. Even very slight differences in the ability of the pollen tubes to reach the micropyle would cause marked distortions in the ratios and should result in different proportions of defective seeds in the upper and lower halves of the inflorescences.

LINKAGE RELATIONS

Although no special study of the linkage relations of these characters has yet been made, it was to be expected that some indications of linkage would be encountered as by-products of the other investigations. This proved to be the case.

The first linkage to appear was that between de_2 and a factor for albino seedlings. This linkage has been briefly mentioned in a previous paper. (Mangelsdorf, 1922.)

TABLE 9. Seedlings from Normal and Defective Seeds Showing Linkage Between de_2 and w.

Ear No.	Normal		Defective	
	Green	White	Green	White
2	126	15	30	20
4	158	19	23	19
5	79	19	0	19
7	130	20	1	39
8	119	1	28	32
Total	612	74	82	129

As already noted, the de_2 character is peculiar in that it is greatly modified in certain crosses. In a cross between the de_1 and de_2 stocks the recessive seeds of the latter reappeared, so altered in appearance, and so well developed, that it was considered feasible to plant a row of them in the field in order to secure a stock homozygous for this factor. A week later when the seedlings had emerged, this row was easily the most conspicuous one in the field. With one exception all of the seedlings were albinos, and this solid row of pure white seedlings in striking contrast to the normal green plants on either side furnished a most striking demonstration of linkage.

The remaining ears of this cross were tested in the greenhouse and the results are given in Table 9. Figure 62 shows the seedlings grown from the normal and defective seeds from one of these ears.

The amount of crossing over between de_2 and w is 18 per cent as determined from the normal seeds and 21.5 per cent as determined from the recessive seeds.

These values are believed to be somewhat high because of possible inaccuracies in the classification of normal and defective seeds on these ears. A large number of F_3 progenies were therefore grown. In these the development of the defective seed was reduced, and the segregation so well defined that, it is believed,

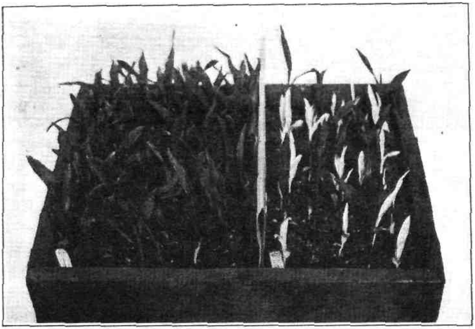

FIG. 62.—Seedlings from normal and defective seeds of de_2 showing linkage between defective seeds and a factor for white seedlings.

a fairly accurate separation was made. The results of planting the normal and defective seeds from 17 F_3 ears are given in Table 10.

The amount of crossing over as determined from the normal seeds is 11.7; from the defective seeds, 10.5.

As nearly as can be determined from the records the de_2 stock is the same one in which the w_2 factor for white seedlings was found. (Lindstrom, 1924.) The w_2 factor is known to belong to the second linkage group in maize and it is probable, therefore, that the de_2 factor is also a member of this group although further tests are necessary to substantiate such an assumption. Some additional evidence for it exists in the fact that Lindstrom (1923) has also found a case of close linkage between w_2 and a defective seed which answers the description of the de_2 type.

LINKAGE BETWEEN *su* AND *de* FACTORS

The relation between the factor for sugary endosperm, a representative of the third linkage group, and the fourteen factors for defective seeds, may be determined from the crosses between de_7 and the thirteen remaining types. The de_7 stock, originally starchy, had been changed over to sugary before any crosses were made.

TABLE 10. Seedlings from Normal and Defective Seeds of F_3 Progenies Showing Linkage Between de_2 and *w*.

Normal		Defective	
Green	White	Green	White
84	3	5	28
89	5	16	22
79	17	0	12
83	9	2	32
91	1	27	32
54	7	1	16
58	2	1	2
42	0	0	6
8	3	0	2
63	3	1	25
21	2	3	2
84	8	1	26
81	12	12	33
51	0	0	4
74	9	1	11
68	4	0	15
59	2	2	15
1089	87	72	283

Since the defective seeds, with the exception of two or three types, cannot be accurately classified with regard to their endosperm texture, their linkage relations with sugary must be determined from the normal seeds alone. Linkage of sugary endosperm with any of the lethal factors would be indicated by a distortion of the normal 3 starchy : 1 sugary ratio. An excess of sugary seeds is expected when the sugary and defective seed factors enter the cross from opposite parents and the recessive factor of one is linked with the dominant allelomorph of the other. With complete linkage between *Su* and *de*, 33⅓ per cent sugary seeds in the normal class are expected. Thus the range in crossing over from 50 per cent to 0, corresponds to a range in percentage of sugary seeds of 25 to 33⅓. This is shown diagrammatically in Figure 63.

F_2 progenies of crosses between sugary endosperm and all of the defective seed types have been grown. The results of separating and counting the starchy and sugary seeds in the normal class, on ears from all of these crosses, are shown in Table 11.

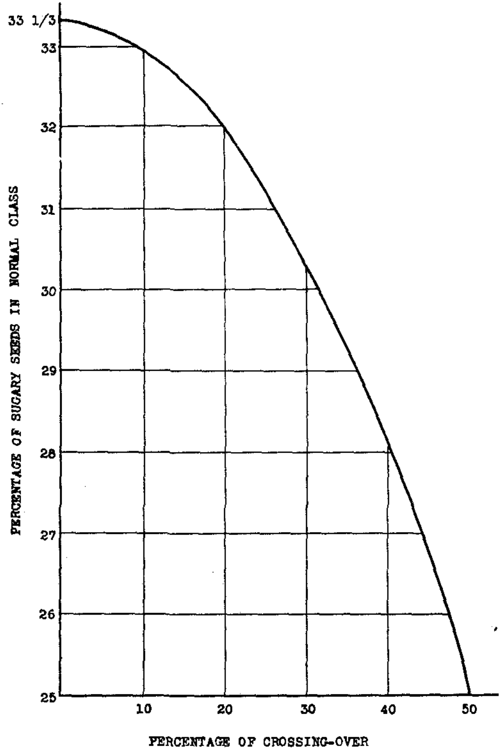

FIG. 63.—Diagram showing the theoretical distortion of the starchy: sugary ratio among the normal seeds when a defective seed factor is linked with the normal allelomorph of sugary. With complete linkage 33⅓ per cent sugary seeds are expected in the normal class.

TABLE II. Segregation of Starchy and Sugary among the Normal Seeds of Ears also Segregating for Defectives.

Cross	Ear No.	Starchy	Sugary	% Sugary
*de*₁ x *su*	947	71	36	
"	951	213	89	
"	953	219	81	
"	956	98	32	
	Total	601	238	28.4
*de*₂ x *su*	1024	217	91	
"	1034	131	42	
"	1035	173	52	
	Total	521	185	26.2
*de*₃ x *su*	1013	255	98	
"	1016	352	100	
"	1017	223	89	
	Total	830	287	25.7
*de*₄ x *su*	1045	185	75	
"	1047	150	37	
"	1049	244	87	
	Total	579	199	25.6
*de*₅ x *su*	1056	334	97	
"	1058	330	115	
"	1068	421	128	
	Total	1085	340	23.9
*de*₆ x *su*	1107	66	37	
"	1108	138	55	
	Total	204	92	31.1
*de*₇ x *su*	1072	187	58	
"	1073	291	114	
"	1084	252	90	
	Total	730	262	26.4
*de*₈ x *su*	2432	287	111	
"	2433	252	75	
	Total	539	186	25.7
*de*₉ x *su*	1096	200	62	
"	1098	177	50	
"	1102	242	72	
	Total	619	184	22.9

TABLE II (*cont'd*). Segregation of Starchy and Sugary among the Normal Seeds of Ears also Segregating for Defectives.

Cross	Ear No.	Starchy	Sugary	% Sugary
$de_{10} \times su$	996	278	88	24.0
$de_{11} \times su$	969	295	104	
"	970	137	43	
"	971	228	54	
	Total	660	201	23.3
$de_{12} \times su$	937	306	95	
"	938	298	105	
"	940	170	45	
	Total	774	245	24.0
$de_{13} \times su$	1075	222	70	
"	1079	135	51	
	Total	357	121	25.3
$de_{14} \times su$	981	162	55	
"	988	345	111	
"	992	231	83	
	Total	738	249	25.2

With the exception of the cross involving de_7, the lethal factors and the factor for sugary endosperm have been contributed by opposite parents and linkage would be indicated by an excess of sugary seeds. In the cross of de_7, the *de* and *su* factors were introduced by the same parent and linkage would be indicated by a deficiency of sugary seeds.

The only crosses in which there is a noticeable distortion of the starchy-sugary ratio are those involving the de_1 and de_8 factors. In the former 28.4 per cent of the normal seeds are sugary. This is an excess of sugary seeds of 3.4 times the probable error and indicates linkage with crossing over of 38.5 per cent. Fortunately the defective seeds of this type can also be readily classified as to their endosperm texture and this is done in Table 12.

Among the defective seeds there is a marked deficiency of sugary individuals, only 20.6 per cent being found as compared to 28.4 per cent in the normal class. The amount of crossing over as determined from the defective seeds is 39 per cent. This agrees very closely with the percentage as determined from the normal seeds. The evidence is fairly good, therefore, that the de_1 and *su* factors are linked.

TABLE 12. Segregation of Starchy and Sugary among the Defective Seeds from Ears of a Cross de_1 x *su*.

Ear No.	Starchy	Sugary	% Sugary
947	42	10	19.2
951	75	27	26.5
953	85	18	17.5
956	45	9	16.7
Total	247	64	20.9
Ex. 3:1	233	78	25.0
Deviation	14	—14	4.4
Probable Error:	5.15		

In the cross of de_6 x *su*, 31.1 per cent of the normal seeds were sugary. This is an excess of 3.6 times the probable error and indicates linkage with crossing over of 26 per cent. Unfortunately the defectives on these ears could not be classified with regard to their endosperm texture and it is not so certain that linkage between de_8 and *su* exists, although it is strongly indicated. An excess of sugary seeds of 3.6 times the probable error would be expected as a chance deviation only once in about 65 trials.

The cross between the de_1 and de_8 factors shows independent inheritance of these two characters as is shown in Table 13. This would be expected even though both are linked with the *su* factor providing that the loci of the two lethals were on opposite sides of the *su* locus.

TABLE 13. Segregation in F_2 of a Cross between de_1 and de_8 Showing Independent Inheritance.

Ear No.	Normal	Defective
166	124	103
168	117	83
175	161	142
178	195	131
Total	597	459
Ex. 9:7	594	462
Deviation	3	—3

LINKAGE OF DEFECTIVES WITH EACH OTHER

In most varieties of maize there are ten pairs of chromosomes. (Kuwada 1915, Kiesselbach and Petersen 1925.) Therefore, in crossing thirteen different factors in all combinations some cases of linkage are almost certain to occur. The difficulty lies in their detection. With independent inheritance two defectives when crossed give a 9:7 ratio in F_2. With complete linkage these two defectives should give a 1:1 ratio. Thus the entire range of cross-

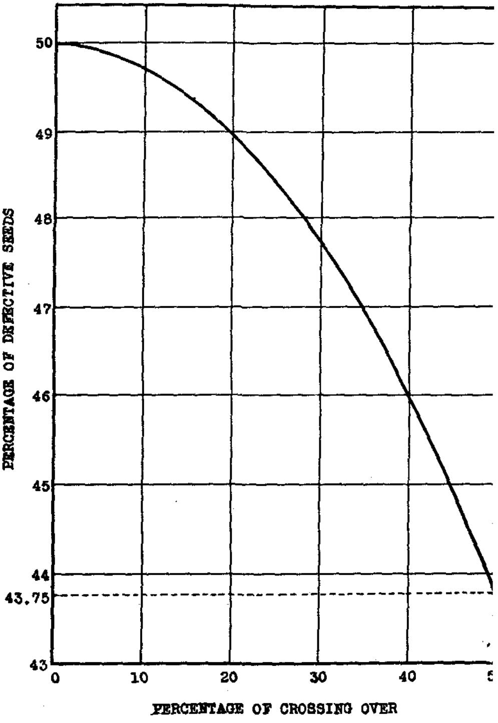

FIG. 64.—Diagram showing how linkage between two defective seed factors would distort the normal 9:7 di-hybrid ratio. If each defective is completely linked with the dominant allelomorph of the other, a 1:1 ratio is expected.

ing over from 50 per cent to 0 corresponds to a range of 43.75 to 50 in the percentage of defectives. This is shown diagrammatic-

ally in Figure 64. Since deviations of two and three per cent are expected to occur fairly frequently by chance alone, the difficulty of detecting any but the closest linkages is at once apparent. However, the fact that defectives often show a deficiency and very

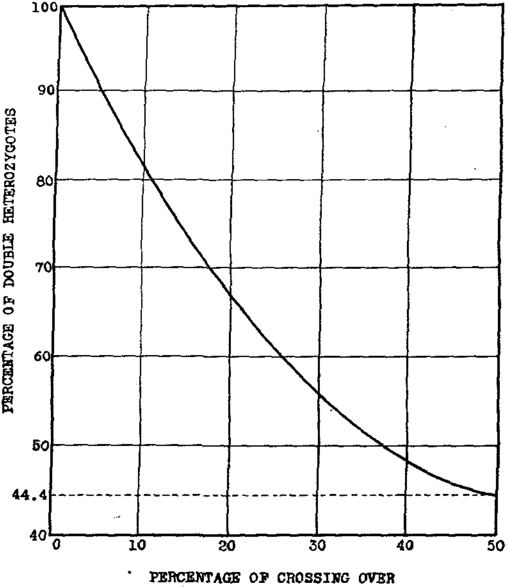

FIG. 65.—Diagram showing how linkage between two lethal factors brought in from opposite parents causes an increase in the proportion of heterozygotes.

rarely an excess, makes it necessary to regard any di-hybrid ears which produce more than 43.75 per cent defectives as possible cases of linkage. Further evidence must then be obtained by growing additional di-hybrid ears or by examining F_3 progenies. If the high percentage of defectives in F_2 is due to linkage, then

the F_3 should produce an excess of heterozygous plants as well as an excess of recessive seeds on a majority of the di-hybrid ears. In other words, when two defectives, whose factors occupy loci on homologous chromosomes, are brought together, a condition of balanced lethals is automatically set up. With complete linkage these two lethals, when once brought together, can never be separated and only di-hybrid ears all of which give 1:1 ratios will be produced thereafter. The diagram in Figure 65 shows how, with such a condition of balanced lethals, the proportion of double heterozygotes in F_3 is expected to increase with the intensity of the linkage.

Balanced lethals were first suggested by Renner (1916) as a possible explanation of some of the peculiar results from the breeding experiments with *Oenothera*. De Vries (1916) adopted the explanation to account for the production of twin hybrids in crosses of this species, but he failed to appreciate the full significance of the effects of lethals in a balanced condition. It remained for Muller (1918) in his classic contribution on the inheritance of the beaded wing character in *Drosophila* to show the bearing of balanced lethals on constant hybridity, the sporadic appearance of certain "mutants" due to crossing-over, and the production of twin hybrids.

Of the 59 crosses shown in Figure 54, in which di-hybrid ears have been obtained, those which have given marked excesses of defective seeds are shown in Table 14.

TABLE 14. *Crosses of Defective Seeds which Produced an Excess of Recessives in* F_2.

Cross	Normal	Defective	% Defective
$de_{10} \times de_3$	418	376	47.4
$de_6 \times de_5$	270	235	46.5
$de_{10} \times de_6$	64	59	48.0
$de_{14} \times de_{11}$	275	251	47.7

F_3 progenies of only one of these crosses, $de_{10} \times de_3$, have been grown. Twelve self-pollinated F_3 progenies were obtained of which five were segregating for both types of defective seeds. Although the di-hybrid ears are not in excess, as would be expected under balanced lethal conditions, the sample is too small to permit any final conclusion on this point. When the normal and defective seeds on these five di-hybrid ears are counted, it is found that there is again an excess of the recessive seeds as is shown in Table 15.

When these five progenies are combined with the two F_2 progenies already shown, making a total of 1060 normal to 916 defectives, the deviation is 52 ± 13. The average percentage of defective seeds is found to be 46.3, which indicates linkage with crossing over of 38.5 per cent.

TABLE 15. Normal and Defective Seeds from F_3 Progenies of a Cross of de_{10} x de_5 Indicating Linkage between These Factors.

Ear No.	Normal	Defective	% Defective
858	112	99	46.9
859	130	100	43.5
862	132	112	45.9
867	125	105	45.7
868	143	124	46.4
Total	642	540	45.7
Expected	665	517	43.7
Deviation	—23		
P. E. = 11.5			

It should be mentioned, that with a condition of balanced lethals, occasional progenies are expected in F_3 in which there is a deficiency of recessives instead of an excess. This condition would be brought about through crossing over so that the two lethal factors, originally on homologous chromosomes, are now borne on the same chromosome. Thus unless the linkage between the two lethals were fairly close, so that the excesses and deficiencies within each progeny were sufficient to permit a separation, the two types of F_3 progenies would tend to balance each other and linkage would be almost impossible to detect.

LINKAGE OF DEFECTIVES WITH GROWTH FACTORS

The method of improving corn by selection in self-fertilized lines aims at the removal of all recessive abnormalities such as white seedlings and defective seeds. There seems to be a general belief that these factors have a deleterious effect, even in the heterozygous condition.

Lindstrom (1920) suggests that these recessive abnormalities, if they do have an unfavorable effect in the heterozygous condition, are permitted to persist in the germplasm only when they are linked with particularly good growth factors, and that in removing them by inbreeding, some of the best germplasm is lost. Jones and Mangelsdorf (1925) have shown, however, that inbred strains from which all recessive abnormalities have been eliminated, yield fully as well as sister strains which still carry one or more of these abnormal characters. Apparently nothing of value was lost through their elimination; neither was there any marked improvement when their supposedly unfavorable influence was removed. Still assuming that these factors have an influence in the heterozygous state, a probable explanation of these conflicting results is that the defective seeds and other lethal abnormalities are permitted to persist and accumulate, not because they are linked with especially good factors for development, as Lindstrom has suggested, but because their presence tends to keep short sections of the chromosomes which they occupy in a continued state of hetero-

zygosity. The increased vigor which results from such enforced heterozygosity of the accompanying growth factors enables the recessive abnormalities to survive in the germplasm even though they have an unfavorable influence in themselves.

Furthermore, when two such lethal factors which occupy homologous chromosomes are brought together, a condition of balanced lethals is set up which may so increase the vigor of the stock by keeping whole chromosomes or large sections of chromosomes in a continued state of heterozygosity, that the lethals are actually given an advantage and are able to survive even though they are linked with especially poor growth factors instead of particularly good ones.

Shull (1923) has pointed out that varieties of *Oenothera* which carry lethal factors are, in general, more vigorous than those which lack these characters. The mechanism of crossing over in *Oenothera* appears to be different from that in most species as is shown by both cytological and genetic studies; Shull (1923), Cleland (1925). All of the characters so far studied in this species fall into a single linkage group and the amount of crossing over between the members of the group is relatively low. It is possible, therefore, that lethal factors in *Oenothera* keep all of the chromosomes, with their hereditary factors for growth and development, in a continued state of enforced heterozygosity. If such is the case, then the increased vigor brought about in *Oenothera* by the presence of lethal factors is probably more marked than would occur in other species where there are as many linkage groups as chromosomes.

A PLANT CHARACTER FOR DEFECTIVE SEEDS

In addition to the thirteen endosperm characters which cause one-fourth of the seeds on segregating ears to be defective, a plant character which causes defectiveness in all the seeds on one-fourth of the plants has been found.

This character appeared in the de_{13} stock which was received from Mr. H. A. Wallace of Des Moines, Iowa. Mr. Wallace had found among the plants of the variety "Illinois Two Stalk" several which produced only aborted seeds, and which appeared to be homozygous for defective seeds. Pollen from one of these plants applied to a hybrid of inbred strains known to be free of hereditary defectives produced only normal seeds. The F_1 plants grown from these normal seeds were selfed and produced some ears which were segregating for defective seeds of the type which has already been described as de_{18}. Not all of the ears were segregating, however, as should have been the case, had one of the parents been homozygous for the defective factor. Nor did the recessive seeds on the segregating F_1 ears resemble the

aborted seeds of the pollen parent. The extracted recessives on the F_1 ears were completely aborted, appeared to have no endosperm tissue and showed no germination whatever. It was difficult to understand how this type could have been obtained in a homozygous condition, or why, if the pollen parent was homozygous for defective seeds, only part of the F_1 ears were segregating for the character.

This confusing situation was cleared up, however, when a large number of F_2 ears, which had been grown for another purpose, were harvested. A total of 201 F_2 ears were examined and of these 51, or almost exactly one-fourth, bore only aborted seeds and were identical in appearance to the ears of the grandparental pollen parent. The other 150 ears were normal in appearance although some were segregating for defective seeds and others were not.

Apparently the plant of "Illinois Two Stalk" which served as the pollen parent for this cross, in addition to being heterozygous for a recessive endosperm character de_{13}, was homozygous for a recessive plant character, to which the symbol de_{pl} may be given. On this hypothesis the genetic composition of the parental stocks and the F_1 seeds is as follows:

Pollen parent	De_{13} de_{13} de_{pl} de_{pl}
Seed parent	De_{13} De_{13} De_{pl} De_{pl}
F_1 Seeds	De_{13} De_{13} De_{pl} de_{pl} De_{13} de_{13} De_{pl} de_{pl}

Half of the F_1 seeds when selfed should produce ears segregating for the endosperm character de_{13}. The other half should give only normal seeds. Apparently these conditions have been met; of the five F_1 ears which had been selfed 3 were segregating for defective seeds and two were not.

That the new variation de_{p} is actually a plant character is further demonstrated by the fact that the recessive plants produce only defective seeds regardless of the pollen which they receive. If it were an endosperm character cross pollination with normal plants should give only normal seeds.

The seeds on the defective ears show considerable variation in development, some being almost completely defective, others only partially so. None, however, are as fully developed as normal seeds, though many are capable of germination and when grown produce fairly vigorous plants which in turn bear only defective ears. Defective ears from such homozygous plants are shown in Figure 66.

There seems to be no relation between the defective seed type which appeared in the F_2 endosperm generation and the defective ears which came to light in the F_2 plant generation. The fact that both came out of the same cross is regarded merely as a

coincidence. The two have now been separated and stocks segregating for one and lacking the other have been obtained.

This variation is of interest in connection with the defective seeds because it produces practically the same effect in the individual seeds as do some of the endosperm characters.

The character of the endosperm is usually determined by the genetic constitution of the zygote* which results from the fusion

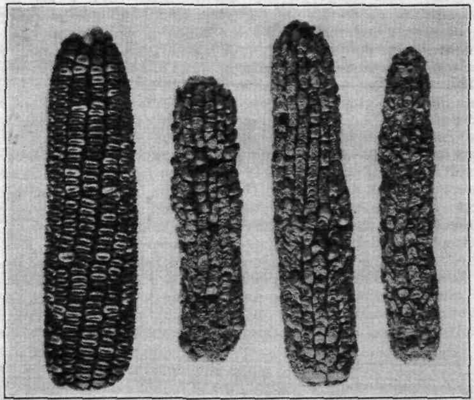

FIG. 66.—Normal and defective ears of the de_{pl} stock. This factor causes all of the seeds on one-fourth of the plants to be defective *regardless of the genetic constitution of the endosperm.*

of the endosperm nuclei with a sperm nucleus. The defective ear, however, represents a condition in which the expression of the hereditary factors of the new sporophyte is prevented. Apparently there is present or lacking, in the recessive plants, something which causes all of their seeds to be aborted regardless of the genetic constitution of the seeds themselves. Such a situation might be compared to a population of plants in which all the plants were dwarfed because of a lack of moisture or fertility,

* To be strictly accurate, perhaps the term "zygote" ought not to be applied to the *endosperm, but its use in this connection* is probably less confusing than would be the adoption of a new term.

while in a better environment some of the plants would be tall and others dwarfed, because of the hereditary factors which they carried.

DISCUSSION

The fact that defective seeds have been noted in almost every variety of maize which has been examined and that only in one case have two, from different varieties, been found which have proven to be genetically alike, gives some indication of the enormous number of these characters which probably exist. The appearance of defective seeds in a homozygous inbred strain, as the result of mutation, four separate times in four years, furnishes a hint as to their probable origin. The histological studies indicate that these characters do not affect specifically the endosperm or embryo. *They are, apparently, merely variations which are extremely deleterious in their influence and their major effect is seen in the endosperm generation only because the period between fertilization and the maturity of the seed provides the first opportunity for their expression.* There is some indication that these factors also have an unfavorable influence in the heterozygous condition and the fact that they survive and accumulate in the germplasm may imply that they tend to keep other factors, which affect development, in a continued state of heterozygosity.

From the economic standpoint these characters are probably of no direct importance. From the standpoint of the geneticist they offer a vast amount of new material which may prove useful in charting the germplasm of this species.

Summary Part I

1. Defective seeds are lethal or semi-lethal characters which affect the normal development of the seed.

2. These characters have been noted in many varieties of maize and it is estimated that one plant in every thirty, on the average, is heterozygous for defective seeds.

3. Defective seeds have been the most frequent variations to arise by mutation in homozygous inbred strains of maize.

4. Fourteen stocks segregating for defective seeds have been crossed in 82 combinations. Only two of these which are genetically alike have been found.

5. Histological studies show that normal fertilization apparently occurs in the formation of these seeds, and that both endosperm and embryo are produced. These structures develop very slowly, however, and remain rudimentary. Both are affected to almost the same degree by the influence of the lethal factors.

6. The relative development of the fourteen stocks of defective seeds as compared to normal seeds on the same ears ranges

from 2.4 per cent to 59 per cent, based upon the dry weight of the seeds.

7. The following indications of linkage have been encountered:

The de_2 factor with a factor for white seedlings, probably the w_2 factor, which is a representative of the second linkage group. Crossing over is about 11 per cent.

The de_1 and de_8 factors with the factor for sugary endosperm which is a representative of the third linkage group. Crossing over in the first case is 39 per cent, in the second 26 per cent.

Linkage between two different defectives is indicated in four crosses.

8. In addition to the 13 endosperm characters which cause one-fourth of the seeds to be defective, a plant character which causes all of the seeds on one-fourth of the plants to be defective, has been found.

PART II

Non-Hereditary Defective Seeds

Almost every ear of maize bears some aborted seeds. On most ears only a few of these are found scattered at random throughout the inflorescence; on others, entire regions of the ear produce only defective kernels. These undeveloped seeds have commonly been attributed to "imperfect pollination" though it has never been clear just what conditions were included by this term. It is now evident that many of these abortive seeds are lethal or semi-lethal characters, inherited as simple Mendelian recessives, but it must also be recognized that there are, in addition to the hereditary characters, various other types of defective seeds which do not appear to have an hereditary basis or at any rate are not inherited as recessive endosperm characters.

These non-hereditary types are formed regardless of whether the ear is self-pollinated or cross-pollinated. They are found in all varieties and occur as frequently in homozygous inbred strains as in ordinary heterozygous varieties. In appearance they are practically identical to some of the hereditary types, and in separating dominant and recessive individuals from a segregating ear, they are included with the latter. Because they sometimes represent a significant source of error in classification, it has been considered important to determine the frequency of their occurrence, the conditions causing their production and, if possible, some means of distinguishing them from the Mendelian characters which they resemble so closely.

A microscopic examination of sectioned material from various sources showed that there are at least four morphologically distinct types of non-hereditary defective seeds and that these are probably produced as the results of the following conditions:

1. Stimulus resulting from pollination without fertilization. (Parthenocarpy.)
2. Arrested development due to competition, dominance or other physiological conditions.
3. Irregularities in the mechanism of fertilization.

PARTHENOCARPIC DEFECTIVES

The first of these four types was found on an ear which had been bagged as a pollination check. After a period of several weeks, the silks grew to such a length that some of them protruded from below the bag and became exposed to pollen. As a result, a few of the ovules on this ear developed slightly. These were not normal in appearance and contained, instead of the usual milky fluid, only a clear watery liquid and a jellylike tissue.

Microscopic examination of sections of these ovules showed that their development was due entirely to a marked growth of nucellus. The embryo sac was readily recognized, though it had begun to disintegrate at the apical end and the antipodals had moved into the nucellar tissue. Within the sac was found some disintegrated granular material and, in several specimens, the egg and polar nuclei were still visible. No indications of fertilization were found in any of the sections and no remains of the pollen tube could be distinguished, although these might have been present and not have been clearly brought out by the stain used. In no case was there the slightest trace of endosperm or embryo. The nucellus in maize is very distinct from the endosperm and there is little danger of confusing these two tissues. In none of the specimens examined did the nucellus show any indication of starch grain formation. A photomicrograph of one of these ovules is shown in Fig. 4, Plate XXVI.

The natural conclusion is that no fertilization occurred in these partially developed ovules. Either the pollen tubes failed to reach the micropyle, or if they reached it, failed to accomplish fertilization. Apparently, however, the tubes in growing down the styles had in some way transmitted a stimulus to the ovule which resulted in a marked growth of the nucellus and pericarp, even though fertilization did not occur.

Though the nucellus of maize is of minor importance in the mature caryopsis, becoming compressed into a thin integument by the pressure of the growing endosperm, yet these partially developed, though unfertilized, ovules are comparable in certain respects to some of the seedless fruits which are produced in the absence of pollination, and to which the term "parthenocarpic" has been applied.

The term "parthenocarpy" was first used by Noll (1902) to describe the situation in which certain plants, under exclusion of pollen, are able to form fruits outwardly normal, or nearly so, but in which the seeds are absent or aborted. Noll reported this condition in the cucumber and Ewert (1909, 1910) has noted it in other fruits.

Winkler (1908) makes a distinction between "stimulative" parthenocarpy in which the seedless fruits are produced only after pollination with their own or foreign pollen or in consequence of an insect prick or other irritation, and "vegetative" parthenocarpy in which the seedless fruits occur without the action of pollen or other stimuli.

Wellington (1913) found that in Nicotiana species, capsules were caused to swell by merely tickling them with a sharp-pointed instrument. Abortive seeds, probably without embryos, were produced by singeing the buds with a hot wire, by exposure of the plants to chloroform gas, and by cutting away a portion of the

pistil and pollinating the stub, or by grafting the stigmatic end of another pistil to the excised one and pollinating the new pistil.

These abortive ovules of Nicotiana, as well as those of maize, if they can be legitimately termed parthenocarpic, fall into the category of "stimulative" parthenocarpy since they represent a development brought about by stimuli other than fertilization.

An inflorescence of maize from which pollen has been excluded throughout the season is shown in Fig. 67. Maize never produces seeds of any description in the complete absence of pollen though it may be possible to produce with artificial stimuli, such as used by Wellington in Nicotiana, the same development of the ovules which results when pollen tubes enter the style without accomplishing fertilization.

Parthenocarpy is not to be confused with parthenogenesis. In the former no embryo is produced, in the latter normal seed formation may occur. Parthenogenesis occurs regularly in some plants but, so far as is known, has never been found in maize or closely related species. Parthenocarpy, on the other hand, may be widely distributed. In species such as maize, however, where the stimulated parts are of little importance, parthenocarpy is of significance only as it has a bearing on the physiology of pollination, or represents a source of error in genetic experiments.

SOME CONDITIONS WHICH INFLUENCE THE FREQUENCY OF PARTHENOCARPIC DEFECTIVES IN MAIZE

Several conditions noted in the experience of making artificial pollinations in maize suggested the possibility that the frequency with which parthenocarpic defectives are produced probably depends to a large extent on the age of the silks. As already mentioned, these seeds were first noted on ears which had received no pollen until several weeks after the silks had emerged. An inbred strain of flint corn in which the husks are extremely long, so that the silks must attain a length of 50 cm. or more before emerging, regularly produces a large proportion of parthenocarpic defectives. This same strain bears normal seeds when the husks are cut back.

These conditions suggest that the silks may become of such a length that the pollen tubes are no longer capable of reaching the micropyle or that the embryo sac, after lying idle for so long a period, becomes disorganized and is no longer capable of entering into fertilization even though the styles still retain their receptivity and furnish a medium for the growth of the pollen tubes.

Parthenocarpic defectives are also frequently produced on ears which have been artificially pollinated several days sooner than the normal time. In making hand pollinations it is sometimes necessary to use ears from which the silks have not yet emerged. The husks are cut back to the tip of the spike, exposing silks which under natural conditions would not have been pollinated until

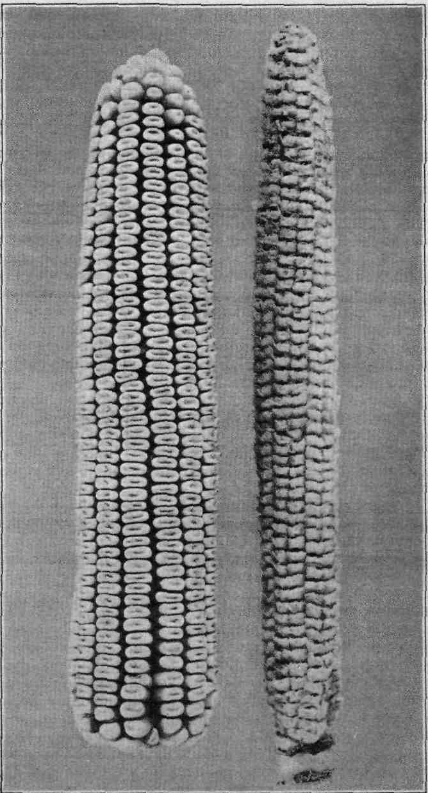

FIG. 67.—An inflorescence from which pollen has been excluded throughout the season, compared to an open-pollinated ear from the same strain. No development of any kind occurs in the complete absence of pollination.

several days later. On ears treated in this manner it is not uncommon for the ovules at the tip to be parthenocarpic, suggesting that the silks are capable of receiving pollen before the embryo sac is ready for fertilization.

INFLUENCE OF AGE OF SILKS

To determine the influence of the condition of the silks on the frequency of parthenocarpy, the following experiments were made: The husks were removed from young ear shoots at periods of about six, four, and two days before the time at which the ears would normally have silked out. The removal of the husks and the surrounding leaf sheath so weakened the stalk at the ear-bearing node that it was necessary to brace the plants by tying them to a thin strip of wood above and below this node.

These immature inflorescences were pollinated with normal pollen from earlier plants and were covered with paper bags after pollination to avoid further exposure. As a check, ears opened at an early stage were covered with paper bags but were not pollinated until several days later, or at about the time that they would have received pollen under natural conditions.

The spikes at six days before silking were very small, and had only a few rudimentary silks, without lateral hairs, at the base. Spikes at four days before flowering time had short but well developed silks at the base and rudimentary hairless silks at the tip. At two days before blooming time the spikes were well covered with silks.

The normal blooming time for all of these plants was determined from sister plants of the same first generation hybrid. Throughout these experiments only plants of a first generation hybrid between two inbred strains were used. These strains were free from any types of hereditary defective seeds and were homozygous for all visible characters. Consequently the plants of the F_1 hybrid were, for all practical purposes, genetically identical and any difference in the number of defective seeds was caused by influences other than heredity. Under uniform soil conditions all plants of this hybrid come into silk at about the same time, making it possible to determine fairly accurately the normal blooming time of the plants which were prematurely pollinated.

In addition to the ears which were pollinated ahead of time, another series was bagged and pollinated at the normal blooming time and at periods of 7, 17 and 25 days later. The results of these premature and delayed pollinations are given in Table 16. The seeds from only a single ear are counted in each case. In the pollinations made at six days before blooming time no seeds were set and in that made at 25 days after silking all the ears

TABLE 16. Influence of the Age of Silks upon the Percentage of Parthenocarpic Defectives.

Days before or after Silking	Total No. of Seeds	No. of Defectives	Percent Defective
6 days before	0	0	0
4 " "	237	85	35.9
2 " "	121	8	6.6
Normal time	783	8	1.0
7 days after	678	11	1.6
17 " "	382	83	21.7
25 " "	60	10	16.7

except one were barren. The one exception produced 60 poorly developed seeds at the tip of the spike of which 50 contained endosperm and embryo and ten were parthenocarpic.

These results indicate that the silks are apparently receptive to pollen for a period greater than that during which fertilization can occur, and that pollinations which are made very early or very late do not accomplish fertilization in many cases but succeed merely in inducing a development of the nucellus and pericarp.

INFLUENCE OF THE AGE OF POLLEN

An experiment was also made to determine whether the condition of the pollen has any influence on the proportion of parthenocarpic defectives which are produced.

This experiment was planned to test the pollen at regular intervals of six hours after collection. In order to avoid the necessity of making some of the pollinations during the night, two collections were made. The first, designated as A in the table, was made at noon, the second, B, from the same plants in the evening, about seven hours later.

The pollen was kept in a cool basement room where the temperature and humidity were relatively constant. Pollinations with the two lots were made every twelve hours on silks which were trimmed off, as nearly as possible, to a uniform length, and a supply of pollen ample to insure full ears under natural conditions was applied. Three ears were pollinated for each six hour period up to 44 hours, which, from previous experience, was considered the maximum period of viability for maize pollen.

When the ears were harvested a marked difference was noted in those resulting from the two lots of pollen. Ears produced from pollination with Lot A were completely filled with the exception of those resulting from the 44 hour pollen. Ears from the B lot were all poorly filled, the earlier pollinations showing a few missing kernels, the later ones, many. Apparently the pollen collected in the evening was injured in some way, perhaps by the higher humidity of the atmosphere at that time.

One ear from each pollination was shelled and the normal and defective kernels counted. The figures are given in Table 17.

TABLE 17. Influence of the Age of Pollen upon the Percentage of Parthenocarpic Defectives.

Hours after Collection	Total No. of Seeds	No. of Defectives	Percent Defective
Lot A			
7	586	23	3.9
19	641	19	3.0
31	718	14	2.0
44	585	46	7.9
Lot B			
0	788	47	6.0
13	554	51	9.2
24	543	57	10.5
37	161	45	28.0

It is noted that in Lot A, where there was apparently an abundance of good pollen at all periods, there is little change in the percentage, of defective seeds, accompanying the increase in age of the pollen. In the ears of Lot B, however, where the number of viable pollen grains was never enough to give completely filled ears, the percentage of parthenocarpic defectives increased progressively with the age of the pollen, beginning with 6.0 per cent at time of collection and ending with 28.0 at 37 hours.

There seems to be no question that the age of pollen has some influence on the frequency with which the parthenocarpic defectives occur. It is probable that in the older pollen many of the grains are capable of germinating but are not vigorous enough to reach the micropyle, and succeed merely in transmitting a stimulus which induces the development of the nucellus and pericarp. Where there is an abundance of pollen these weakened pollen tubes produce no effect since fertilization can be accomplished by more vigorous tubes growing in the same styles. Where the supply of viable pollen is limited, however, so that in many of the styles there is no such competition, the weakened pollen grains germinate but succeed only in producing parthenocarpic defectives.

There are, no doubt, other conditions which influence the appearance of parthenocarpic defectives. Any unfavorable weather conditions, for example, which might prevent the pollen tubes from reaching the micropyle, would probably result in the formation of parthenocarpic defectives. In artificially self-pollinated ears where an abundance of pollen is applied to ears that are fully silked out, the proportion of parthenocarpic seeds which are scattered throughout the ear remains relatively constant. In ears in which it is evident that a large number of these seeds are present

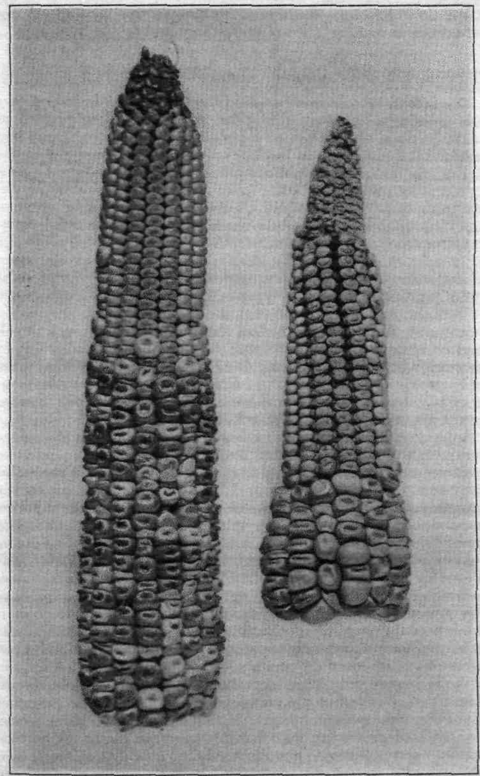

FIG. 68.—Ears which have been pollinated two separate times. The first pollination resulted in normal seeds; the second, made some days later, produced only "arrested" seeds.

at the tip it has been the custom to discard this area of the inflorescence in making a study of the hereditary defective seeds.

ARRESTED DEVELOPMENT

The second type of non-hereditary defective was found on ears in a crossing plot where the pollen parent had been planted at two different times. The first lot of plants to come into tassel had provided pollen enough to fertilize only a few of the ovules on the ears of the de-tasselled pistillate plants. When the second planting came into bloom and pollen was again shed, the seeds resulting from these later pollinations were very small and abortive and never attained a normal development. They differed, in general, from the parthenocarpic defectives, in having a milky opaque appearance in contrast to the clear watery condition of the latter, although this distinction is not marked enough to permit an accurate separation of these two types on the same ear.

Sectioned material showed that these seeds, though abortive in appearance, were quite normal in structure, having a well developed embryo and an endosperm with numerous starch grains in the cells. Instead of growing at a normal rate, however, these seeds grew very slowly and in some cases ceased their development at a stage which corresponds to that found in the normal seed at about ten days or two weeks after fertilization.

Apparently these abortive seeds represent an arrested development, caused by the presence of more advanced seeds on the same inflorescence. This may be merely the result of a competitive effect or it may be due to a sort of "dominance" which the earlier formed seeds have over the physiological processes of the inflorescence, similar to the advantage which a growing tip has over the lateral branches both in plants and in lower animals. The latter possibility is suggested by a condition which is sometimes found on ears in which two separate hand pollinations have been made, the first when only a few silks are out, and the second some days later when the remaining silks have appeared. The first pollination causes the formation of normal seeds at the base of the ear, while the second pollination often results in the production of "arrested" seeds over the remainder of the ear. Such ears are shown in Figure 68. Here the results do not appear to be due to competition alone since the competitive effect would be expected only where the two areas meet. Moreover, the same plant would be capable of producing normal seeds over the entire ear had all the silks been pollinated simultaneously.

In this case, apparently, the first seeds to develop so dominate the physiological processes of the plant, that the later seeds are deprived of normal nourishment. In fact it is not uncommon in such ears for the area containing the arrested seeds to be com-

pletely cut off so that the upper part of the spike disintegrates and is finally pushed off completely.

Seeds of the arrested type are not an important source of error in the defective seed studies, since they occur most commonly when all the silks are not pollinated simultaneously. In some strains, however, they occur regularly even when all the silks are pollinated at once. In such strains due allowance must be made for the disturbance which they cause in the ratios.

IRREGULARITIES IN THE FERTILIZATION MECHANISM

The non-hereditary defectives which are believed to be due to irregularities in the fertilization process are morphologically of two types. The first of these, designated as "germless," contains an endosperm but lacks the embryo, while the second type, termed "miniature," has both structures though these are greatly reduced in size.

In the germless seeds the development of the endosperm varies from a condition in which only a small mass of mealy tissue occurs to one in which well defined floury and corneous regions are distinguishable. In the miniature type the endosperm and embryo are both apparently normal, though the former is greatly compressed by the pressure of the normal seeds on either side and the latter is scarcely half the size of a normal embryo.

These types are found in small numbers on almost any ear of maize. A count of the seeds on fourteen open-pollinated ears of a hybrid between inbred strains known to be free from hereditary defectives, gave total of 10,235 seeds of which 50 or approximately one out of every 205 seeds was germless. The miniature seeds on nine of these ears were also counted and fifteen were found in a total of 6,245 or one in every 416 seeds. The germless seeds apparently occur about twice as frequently as the miniature type.

The suggestion that these two types of non-hereditary defectives, particularly the germless type, are due to irregularities in fertilization, comes from a microscopic examination of sectioned material. In specimens fixed at the early dough stage, it was found that the germless seeds contained normal endosperm tissue and an aleurone layer but that no trace of embryo tissue was present. Opposite the micropyle was a cavity in the endosperm and this appeared to be a remnant of the embryo sac. Within the cavity was found, in two specimens, a single large nucleus, to all appearances the unfertilized or undivided egg, or perhaps the polar nucleus. A photomicrograph of one of these specimens is shown in Figure 3, Plate XXVI.

Apparently this represents a case of single fertilization, in which one of the female nuclei had never been fertilized or, if fertilized,

had not divided. The other nucleus, after fusion, or as the result of some other stimulus, had divided and produced an endosperm, which, though greatly reduced in size, was normal in structural details, the cells being packed with starch grains.

There is, of course, the possibility that fertilization did not occur at all; that the aborted endosperm was produced vegetatively by the division of the polar nuclei. The endosperm of maize is usually the product of a sexual fusion in which one of the sperm from the pollen tube fuses with the two polar nuclei of the embryo sac. In gymnosperms, however, and in some angiosperms, the endosperm is formed independently of any fusion and in some species, where fusion naturally occurs, endosperm formation may be induced by artificial stimuli.

From the experience of artificial pollinations in maize it can be positively stated that no development of the endosperm occurs in the complete absence of pollination. However, the parthenocarpic defectives, already described, show that the mere growth of the pollen tube in the style, transmits a stimulus to the ovule which causes the nucellus to expand and the pericarp to grow. It would, therefore, not seem to be an impossibility for the same stimulus of pollination to occasionally induce endosperm formation even though actual fertilization did not occur. In other words, a condition regularly found in the gymnosperms and some of the angiosperms, might be encountered occasionally as an irregularity in this particular angiosperm.

That the endosperm of the germless seeds is not produced vegetatively by the division of one or both of the unfertilized polar nuclei, is shown by a series of pollinations in which dominant aleurone and endosperm color characters are introduced by the pollen parent. On ears of a variety with white endosperm pollinated by one in which the endosperm is yellow, all of the germless seeds with sufficient tissue to show any color, were yellow. On ears of a strain with colorless aleurone, pollinated by a type with purple aleurone, the most developed of the germless seeds were purple. The appearance, due to xenia, of these dominant characters from the pollen parent, leaves no doubt that the male nucleus has taken part in the formation of the endosperm tissue of these aberrant seeds and that they are not the result of a vegetative division of one or both of the polar nuclei.

On the other hand, if the germless seeds are due to single fertilization, as first suggested, it seems rather strange that seeds containing an embryo, but lacking the endosperm, are not found as frequently as the reciprocal combination. If only one fertilization occurs, the fusion of egg nucleus and sperm might be expected to take place as frequently as that of polar nuclei and sperm, since under normal conditions the two usually occur almost simultaneously. (Weatherwax 1919, Miller 1919.)

There is the possibility that seeds of this type do occur but that the embryo is so dependent upon the endosperm for nourishment that it fails to develop in the absence of the latter, and seeds resulting from a fusion of sperm and egg nucleus alone are classified as parthenocarpic defectives.

Another possibility is, that if single fertilization occurs at all, it always results in formation of an endosperm regardless of which of the nuclei of the embryo sac was fertilized. Such a situation would be in interesting contrast to other species where irregularities of this sort usually result in the production of embryos. In *Naias major*, for example, Guignard found that in some cases the second male nucleus fused with the synergid

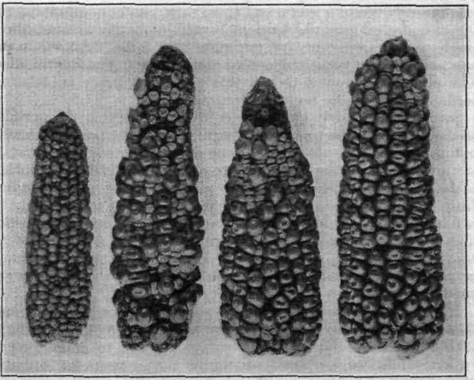

FIG. 69.—Four open-pollinated ears of a homozygous inbred strain showing the varying proportions of non-hereditary defective seeds which may occur under natural conditions.

instead of the primary endosperm nucleus. When this occurred two embryos and no endosperm were produced.

The possibility that single fertilization always results in endosperm formation in this species, is offered only as a suggestion. It seems more probable that seeds with embryos but lacking an endosperm are so poorly developed that they are classed as parthenocarpic and it is expected that such specimens will be encountered when more of the parthenocarpic defectives in early stages of development are examined microscopically.

In this connection it may be mentioned that Harlan and Pope (1925) have recently described a number of defective seeds in barley, in part of which no embryo could be found, in the remainder no endosperm, both types being attributed by them to single fertilization. In the so-called "endosperm deficient" kernels, however, disintegrating masses of tissue whose cells show early stages of starch grain formation are found. These writers believe this tissue to be of nucellar origin.

In the parthenocarpic defectives of maize, in which the nucellus is stimulated to such a marked degree, no evidence of starch grain formation has been found in any stage. Though the possibility of the nucellus assuming the role of an endosperm under some conditions is not denied, it seems more probable, from the description given by these writers, and from their photomicrographs, that the so-called endosperm deficient kernels of barley are not due to single fertilization but are the result of some influence which has arrested the development of embryo and endosperm alike. The photographs show clearly that the embryo in these abortive seeds of barley is by no means normal.

Since there is fairly good cytological evidence that the germless seeds are the product of single fertilization, it is possible that the miniature seeds are also due to some irregularity in the mechanism of fertilization, perhaps to a failure of the antipodal polar nucleus to fuse with the micropylar polar nucleus. Normally the sperm fuses first with the one polar nucleus and almost immediately the two are joined by the second polar nucleus, this process constituting the "triple fusion" characteristic of the formation of the endosperm in many angiosperms. In maize the two polar nuclei never fuse until after fertilization (Miller 1919, Weatherwax 1919).

It is conceivable that occasionally, as often as once in 416 times, this exceedingly precise mechanism might show some variation such that the second polar nucleus would fail to enter into the fusion. Theoretically such a variation would result in formation of embryo and endosperm, though the latter, being the product of the fusion of two haploid entities instead of three would have the diploid instead of the usual triploid number of chromosomes and might be expected to be somewhat reduced in size, as a consequence.

Such a condition is not to be confused with that suggested by Webber (1900) as a possible explanation of mosaic seeds in which part of the endosperm shows maternal characters, the remainder paternal. Webber thought that these seeds might be due to a fusion of the sperm with one polar nucleus while the second polar nucleus divided vegetatively, the two tissues growing side by side. East and Hayes (1911) suggested that these seeds were due to a vegetative segregation, and Emerson (1921) has recently

presented considerable evidence indicating that the mosaic seeds are the result of non-disjunction of single pairs of chromosomes.

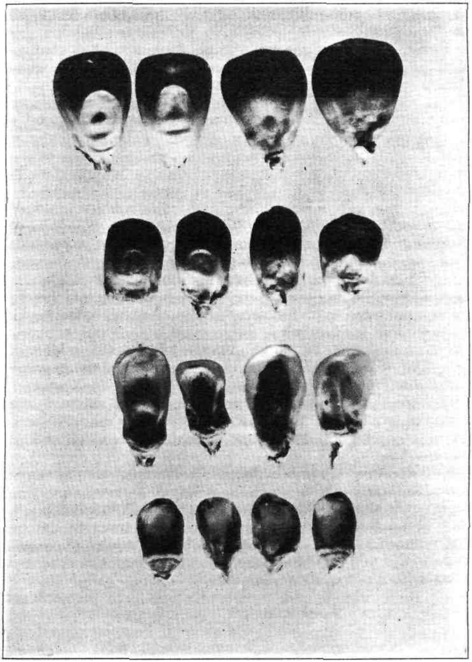

FIG. 70.—From top to bottom: normal, miniature, germless, and parthenocarpic defectives from same ear. The miniature seeds contain both endosperm and embryo, the germless seeds only an endosperm, while the parthenocarpic defectives lack both structures.

The suggested expanation of the miniature seeds, on the other hand, is that one of the polar nuclei is fertilized but that the other,

failing to fuse, does not divide and plays no part in formation of the endosperm.

Whether or not the miniature and germless seeds are due to the irregularities in the mechanism leading up to fertilization, which have been suggested, is not of first importance. Such a precise mechanism as is found in maize might be expected to show occasional accidental variations, and such variations would probably result in defective seeds. The fact of main importance, however, is that these two distinct types of non-hereditary defectives appear with a regularity that makes them a small, though constant, source of error in genetic studies of the hereditary types which they resemble so closely.

Summary—Part II

1. Four morphologically distinct types of non-hereditary defectives, which resemble in appearance certain of the hereditary types discussed in Part I, have been found.

2. "Parthenocarpic defectives resemble complete defectives. They contain neither endosperm or embryo and are the result of a marked growth of the nucellus and pericarp following pollination without fertilization.

3. The frequency of parthenocarpic defectives is influenced by the age of silks, age of pollen, and probably by other environmental conditions.

4. "Arrested" seed contain endosperm and embryo but both structures are retarded in their development due to competition or physiological dominance of normal seeds on the same inflorescences.

5. "Germless" seeds contain endosperm tissue but no embryo. Cytological examinations indicate that these seeds are due to single fertilization instead of the usual double fertilization.

6. "Miniature" seeds are normal in structure though somewhat reduced in size. It is suggested that they are the result of irregularities in fertilization such that their endosperm is diploid instead of triploid in its chromosome number.

PART III

Genetic Factors Which Influence the Texture of the Endosperm

In addition to the thirteen, and probably many more, genetic factors which primarily affect the *amount* of endosperm produced, there are a number of others which govern the chemical or physical nature of the storage material and result in differences in the *texture* of the endosperm.

Several of these factors are already familiar to geneticists. Three of them, sugary, waxy, and shrunken, are inherited as simple Mendelian recessives and are complementary in their action, crosses between any two of these types resulting in starchy F_1 seeds.

The texture of the endosperm of flint and flour varieties of corn has also been found to show alternative inheritance in some crosses. These characters differ from the other three in that a double dose of one is always dominant to a single dose of the other, with the result that the F_1 seeds of a cross are always maternal in appearance no matter which way the cross is made, while the F_2 progenies show a 1:1 segregation no matter which type of F_1 seeds is planted. (Hayes and East, 1925.)

To these already familiar characters affecting the texture of the endosperm, must be added another one, *brittle*, which has appeared in the course of these investigations.

BRITTLE ENDOSPERM*

In 1922, in a lot of about 100 self-pollinated ears of Sanford White, a typical eight-rowed, New England flint variety, were found two ears which segregated for an endosperm character which had not been noted previously. In appearance the recessive seeds on these two ears were somewhat similar to the familiar sugary seeds, being translucent instead of opaque and wrinkled instead of smooth. They differed from sugary seeds, however, in being generally less wrinkled and having a more shrunken appearance. In fact, except for the translucent condition, they were not unlike the shrunken seeds described by Hutchison.

On examination, the endosperm of these aberrant seeds was found to consist of a mass of amorphous tissue, distinctly sweetish to the taste and very brittle in texture. Because of this latter feature the new character has been given the name *brittle* endosperm and the factor symbol *bt*.

* Prof. J. B. Wentz, Iowa State College, writes that he has recently sent to the Journal of Heredity a manuscript in which he describes this same character as *concave*.

Some of the brittle seeds from one of these ears were planted in 1923. Though the germination was poor and the plants lacked somewhat in vigor, a few self-pollinated pure brittle ears were obtained. The original segregating ear and one of the brittle ears derived from it are shown in Figure 71.

When outcrossed to an unrelated stock the brittle seeds reappeared in the F_2 endosperm generation as simple Mendelian recessives. A count of the normal and brittle seeds from five self-pollinated ears of such a cross is given in Table 18.

TABLE 18. Starchy and Brittle Seeds on Self-pollinated Ears.

Ear No.	Starchy	Brittle
1747	212	61
1748	349	91
1749	273	93
1750	190	57
1751	335	104
Total	1359	406
Ex. 3:1	1324	441
Deviation 35		
P. E., 12.27		
Dev./P. E., 2.9		

Because this new character resembled, in some respects, both sugary and shrunken endosperm, it was crossed with both of these. The F_1 seeds in both series of crosses were starchy, indicating that brittle endosperm is a condition genetically different from either sugary or shrunken.

SUGARY X BRITTLE

Although the brittle seeds on the original segregating ear were similar to sugary seeds in appearance, the two types were distinguishable and could be separated with a fair degree of accuracy when both occurred on the same ears. In addition to the general differences already mentioned, it was noted that on ears of which all the seeds were genetically white, the brittle seeds were characterized by a faint yellowish cast, a sort of discoloration of the endosperm, while the sugary seeds, like the starchy, were a clear white.

Table 19 gives the results of separating the starchy, sugary, and brittle kernels from three ears and Figure 72 illustrates the P_1, F_1, and F_2 ears of this cross.

Although the results fit a 9:3:4 ratio the deviation from expectation is rather high, there being an excess of starchy and a deficiency of sugary seeds greater than four times the probable error. The deviation of the brittle seeds is within the limits of random sampling. The marked deviation in the starchy : sugary

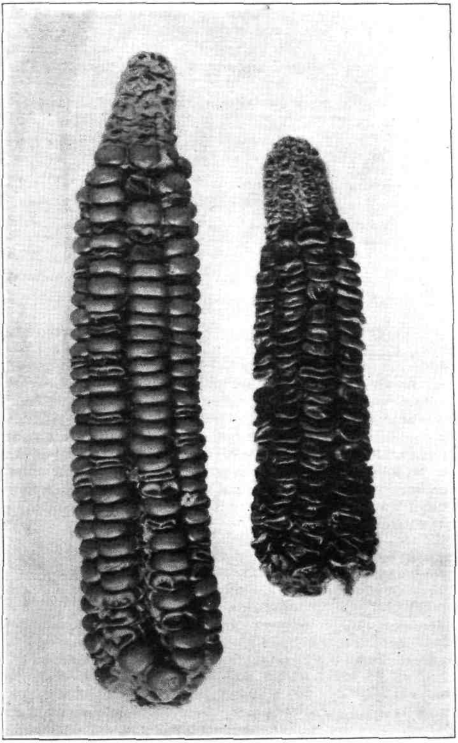

Fig. 71.—Original ear of Sanford White segregating for brittle endosperm and a pure brittle ear derived from it.

ratio may be due to genetic factors affecting the rate of pollen tube growth which are discussed in Part V, published elsewhere

(Mangelsdorf and Jones, 1926). In spite of these deviations the results show that sugary and brittle endosperm are due to two distinct genetic factors which are probably independent in inheritance, no indications of linkage being shown in this cross.

TABLE 19. Starchy, Sugary and Brittle Seeds in the F_2 Endosperm Generation of a Cross between Sugary and Brittle.

Ear No.	Starchy	Sugary	Brittle
422	242	61	78
1754	169	47	63
1755	166	43	72
Total	577	151	213
Ex. 9:3:4	530	176	235
Deviation	47	—25	—22
P. E. 9:7 ratio 10.26			
Dev./P. E. 4.6			

SHRUNKEN X BRITTLE

Only two segregating F_2 progenies of this cross were obtained. A count of the seeds on these two ears is shown in Table 20. Because of the variation in the translucent condition of the brittle seeds, an accurate separation of brittle and shrunken individuals was not possible and these two classes have been combined.

It should be mentioned that both of these ears were also segregating for sugary seeds. These could not be classified accurately with regard to the other characters involved in this cross and since sugary is known to be independent of both shrunken and brittle it was considered safe to disregard the unclassified sugary seeds entirely.

TABLE 20. Starchy, Shrunken, and Brittle Seeds in the F_2 Endosperm Generation of a Cross between Shrunken and Brittle.

Ear No.	Starchy	Shrunken and Brittle
1756	122	90
1757	119	61
Total	241	151
Ex. 9:7	220.5	171.5
Deviation, 20.5		
P. E. 6.62		
Deviation/P. E., 3.1		

Although there is a deviation of 3.1 times the probable error, the results approach a 9:7 ratio. This indicates that brittle and shrunken endosperm are due to two distinct genetic factors which are complementary in their action and are inherited independently. Linkage between the *bt* and *sh* factors would be indicated by an

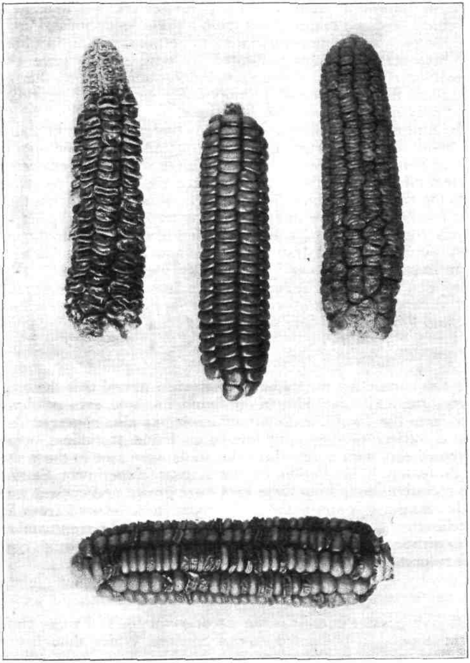

FIG. 72.—Parental, F_1 and F_2 generations of a cross between sugary and brittle endosperm.

excess of the recessive types; actually there is a significant deficiency.

BRITTLE ENDOSPERM FROM TWO VARIETIES

In 1923, Dr. R. A. Emerson, in a letter to Dr. D. F. Jones, wrote that wrinkled, translucent seeds had been found in an inbred

strain of Improved Leaming. These seeds were first thought to be sugary seeds segregating out from a previous accidental cross. The recessive seeds, however, failed to germinate in an incubator and heterozygous plants pollinated by pure sugary gave only normal starchy seeds. These facts led to the conclusion that the new character was a lethal, phenotypically similar to sugary but genetically quite distinct from the latter.

Dr. Emerson very kindly sent seed of the original strain and of the cross. Both lots were grown in 1923 and a number of self-pollinated ears were obtained. Though the recessive seeds of the original inbred strain failed to germinate, the extracted recessives from the vigorous F_1 ears grew readily. When pollen from these pure recessives of Emerson's strain was applied to plants heterozygous for the brittle factor, a 1:1 segregation of starchy and brittle occurred, demonstrating that this new endosperm character from Improved Leaming is genetically identical to the brittle endosperm found in Sanford White. Improved Leaming is a dent variety of Western origin while Sanford White is a New England Flint type of long standing.

SHRUNKEN ENDOSPERM FROM TWO SOURCES

In this connection it may be of interest to record that the character shrunken which Hutchison found in some ears of floury corn from the Ponka Indian reservation has also appeared in a Kansas variety of dent corn known as Pride of Saline. Open pollinated ears with a few shrunken seeds were sent to the writer by Professor J. H. Parker of the Kansas Experiment Station. The recessive seeds from these ears were grown and crosses were made between this strain and a shrunken stock secured from Dr. Hutchison. The F_1 seeds of such crosses were all pure shrunken, demonstrating the genetic similarity of the two parental types with respect to this character.

WAXY ENDOSPERM IN CHINA AND AMERICA

Of even greater interest is the discovery in 1922 of waxy endosperm in two self-pollinated ears of Sanford White, though of a different strain from the one in which brittle endosperm was found.

This peculiar endosperm texture had previously been found only in three isolated localities in China, Burma, and the Philippines. Collins (1920) failed to find a single waxy variety among more than a thousand American varieties which he examined.

The waxy type isolated from Sanford White was crossed with a waxy strain which had come originally from Shanghai, China. This cross gave only pure waxy F_1 seeds, proving that the two strains were genetically alike in their endosperm texture.

So far as is known, the only waxy corn ever grown in Connecticut is the Chinese strain which has been used in genetic investigation at the experiment station farm for a number of years. No corn of any kind has ever been sent from the station to the locality from which the ears of Sanford White were obtained, and it is scarcely possible that the appearance of waxy endosperm in this variety is due to previous crossing with the Chinese waxy. Nor is there any indication that the strain in which waxy has appeared has undergone any recent crossing with such a widely different sort as the Chinese waxy. The strain which carries the waxy endosperm is typical of the variety in every respect, including number of rows of grain on the ear which Collins (in a letter) suggests as the character which would be most affected by crossing.

The origin in an American variety of this peculiar endosperm texture, previously found only in several isolated Asiatic localities, will probably remain a matter for speculation. It may have arisen as a mutation in very recent years or it may have been carried by the stock as a hidden recessive for centuries. Waxy seeds are not particularly conspicuous in appearance and a few such seeds on open pollinated ears would ordinarily escape attention, and the character might be carried along indefinitely. Neither is a recent mutation from starchy to waxy an impossibility, since mutations affecting the endosperm have appeared in homozygous inbred strains of maize in at least four instances, as noted previously.

CONSTANT VARIATION IN THE STORAGE MATERIAL OF THE ENDOSPERM

The finding of brittle endosperm in Leaming and Sanford White, of shrunken endosperm in Pride of Saline and a variety of flour corn from the Ponka Indians, of waxy endosperm in China, Burma, the Philippines, and finally in New England, leads to the conclusion that these recessive characters have a wide distribution in the germplasm of maize varieties, or that the germplasm is constantly producing anew these variations which affect, so profoundly, the nature of the food material stored in the endosperm. Under domestication some of these variations, as for example, sugary, offer economic advantages and are retained. Others may have a survival value under certain climatic conditions and are automatically sorted out. This may have been the origin of waxy varieties in China, Burma, and the Philippines.

It is now generally agreed that maize was confined to the American continent previous to the beginning of the sixteenth century. Why waxy varieties should have been developed in these Asiatic localities and apparently in no other part of the

world is difficult to understand, unless this peculiar type of endosperm has natural advantages under the environmental conditions obtaining in these regions, or unless waxy varieties were isolated because of their economic superiority. Since the waxy corn is generally regarded as inferior to the starchy types for food purposes, where both are known, it seems more likely that the isolation of waxy varieties has been brought about by natural selection. This assumption is substantiated by the discovery of waxy endosperm in varieties of *Coix* and *Andropogon sorghum* from these same regions. (Kempton 1921.)

THE RELATIVE DEVELOPMENT OF ENDOSPERM CHARACTERS

The fact that the brittle seeds show such a low percentage of germination, in some cases none at all, suggests that these various factors which affect the texture of the endosperm are not fundamentally different from the lethal and semi-lethal seeds described in Part I; that all represent "defective" conditions of the endosperm, and that any distinction which is made is one of degree rather than of kind.

It will be recalled that when both normal and defective seed from segregating ears were weighed, the defectives showed a development ranging from 2.4 per cent in the completely lethal types to 59 per cent in the semi-lethal types.

The same method of determining the relative development of these five endosperm characters has been followed. The dominant and recessive seeds from segregating ears were separated, counted, and weighed. The average weight of each type was determined by simple division and the relative development obtained by a comparison of the two quotients.

The average weights of the seeds and the relative development of each type of endosperm texture is shown in Table 21.

TABLE 21. Average and Relative Weights of Dominant and Recessive Seeds fom Segregating Ears.

Character Segregating	No. of Ears	Av. Wt. Dominant Seeds in mg.	Av. Wt. Recessive Seeds in mg.	Rel. Wt. of Recessives
Waxy	3	306	295	96.5
Floury	3	208	199	95.6
Shrunken	3	321	295	91.9
Sugary	5	255	226	88.5
Brittle	2	230	143	62.3

It will be noted that in every case the recessive seeds were lower in weight than the dominant seeds from the same ears. Hutchison (1921) weighed a large number of individual starchy and shrunken seeds from segregating ears and though the shrunken seeds

were lower in weight the difference was not significant when the probable error was considered. He concluded, therefore, that the shrunken seeds were equal to the starchy seeds in their development. Although the method used here does not permit the calculation of probable errors it does give a very accurate average weight of the dominant and recessive seeds. Of the many segregating ears which have been used in these and other determinations not one has ever been found in which the recessive seeds were equal in weight to the dominant ones.

Apparently the seed of maize attains its maximum development only when the endosperm is genetically starchy. Genetic factors which cause the formation of other carbohydrates in the endosperm, such as dextrose in the case of sweet corn, possibly some other sugar in the brittle seeds, and perhaps erythrodextrin in the waxy seeds (Weatherwax 1922), do so at the expense of total dry matter laid down. Although the amount of dry matter is not necessarily the sole criterion of endosperm achievement, it nevertheless appears to be the most important one.

The waxy seeds most nearly approach the normal condition in relative development, the floury seeds come next, followed by shrunken, sugary and brittle in the order given. The germination of the seeds and the vigor of the seedlings is closely correlated with the relative development of each type, the waxy and floury seeds being almost equal to starchy in these respects while the shrunken and sugary seeds are somewhat inferior and the brittle seeds are very poor.

DISCUSSION

These five characters which influence the texture of the endosperm and the thirteen factors which govern the amount of tissue can be arranged in a series representing different stages of endosperm formation. All of the factors result in a decreased development of the endosperm as measured by the dry weight of the seed. When the relative development of these six types is represented by points on the normal growth curve of the seed of maize, together with the thirteen defectives, as shown in Figure 73, it is noted that these 18 endosperm characters form a continuous series ranging from the de_{14} type to waxy endosperm.

In other words, the seeds of maize, to attain a relative development of 100 per cent, must pass safely through all the points represented on the growth curve. This means that *in order to attain the normal or "starchy" condition a seed must be dominant for at least 18 genetic factors*, any one of which in the homozygous recessive condition would reduce its development.

The space on the curve between 50 and 90 is not heavily populated and it is possible that characters which fall into this region are still to be found.

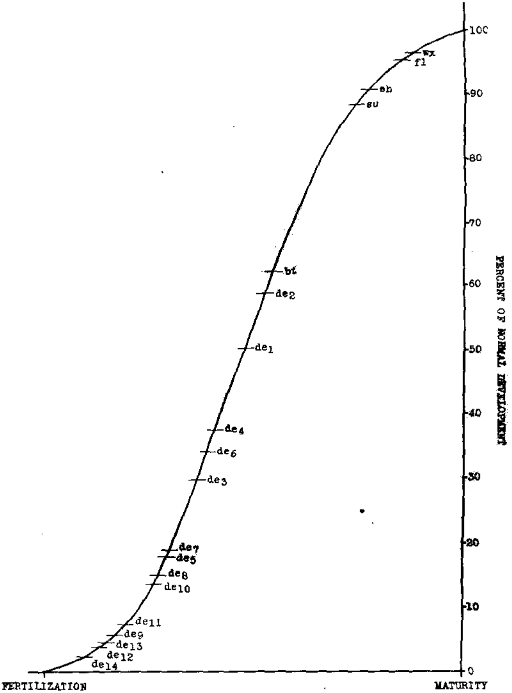

FIG. 73.—Diagram in which the relative development of endosperm characters is represented by points on the growth curve of normal seeds of maize.

The characters which show a development of 50 per cent or more are the most useful to the geneticist because there is enough endosperm development for differences in texture to be apparent

and in most cases these characters can be secured in a homozygous condition. This latter feature constitutes an advantage when linkage relations are studied because it permits the use of backcrosses.

SUMMARY—PART III

1. *Brittle* endosperm, a new character intermediate between sugary and shrunken in appearance, is inherited as a simple recessive.

2. Crosses between brittle and sugary or brittle and shrunken give starchy seeds in F_1 and 9:3:4 or 9:7 ratios in F_2. No indication of linkage is shown in either series of crosses.

3. Brittle, shrunken, and waxy endosperm have been found in widely separated localities and in unrelated varieties indicating their widespread distribution in the germplasm or constant reappearance by mutation.

4. The endosperm of maize apparently attains its maximum development when genetically starchy. The relative development of waxy, floury, shrunken, sugary and brittle seeds is always less than that of starchy seeds from the same ears.

5. The characters which affect the texture of the endosperm are not fundamentally different from the defective seeds previously described, which influence primarily the amount.

6. The maize seed in order to attain the normal or "starchy" condition must be dominant for at least 18 genetic factors.

PART IV

Premature Germination of Maize Seeds and Genetic Factors Which Govern Dormancy

In a paper on defective seeds, the writer (1923) mentioned briefly a condition in maize in which the seeds fail to go through a resting period, germinating while still attached to the ear of the growing plant and before the seed is mature. A similar condition was reported simultaneously by Lindstrom (1923) who found among the ears of a strain of Golden Bantam sweet corn, which was being studied for defective endosperm, one ear which also segregated for germinating seeds. Somewhat later Eyster (1924) described a similar character which he calls "primitive sporophyte,"* and more recently, in another paper (Eyster, 1924), he reports a second factor for premature germination.

Since 1921 a number of stocks which segregate for germinating seeds have come under observation of the writer. Self-pollinations and crosses in these stocks indicate that there are at least five complementary factors and two sets of duplicate factors involved in premature germination of maize seeds. A description of these characters and an account of their genetic behavior is given in the following pages.

COMPLEMENTARY FACTORS

ge_1

The first type of premature germination was found in 1921 in a strain of Gold Nugget flint corn which had been twice self-pollinated. The germinating seeds were not noted in the first generation and either had not appeared, or the germination was so slight as to escape notice. The ratio of dormant to germinating seeds was approximately 3:1 and the character has continued to behave as a simple Mendelian recessive both in the original strain and in crosses. A count of the dormant and germinating seeds from eight ears of this stock is shown in Table 22.

Premature germination induced by the ge_1 factor begins at an

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* The term *primitive sporophyte* as used by Eyster in describing premature germination in maize, has not been adopted by the writer because it is thought to be somewhat misleading. Eyster compares the condition in maize to that found in *Selaginella ruprestris* in which the sporophyte develops while the egg is still attached to the female gameteophyte. The resemblance between this condition and that found in maize is more superficial than real. As a mere term to designate the character, primitive sporophyte would serve as well as any, except for the fact that readers, not familiar with the premature germination in maize, might draw the conclusion that prematurely germinating seeds actually represent a reversion to the primitive condition of the race and that a change in a single gene can carry back the maize plant, phylogenetically, so to speak, to the group in which the club mosses are found.

early stage. The actual sprouting of the seed has usually occurred when the seeds are in the late milk stage but the segregation is

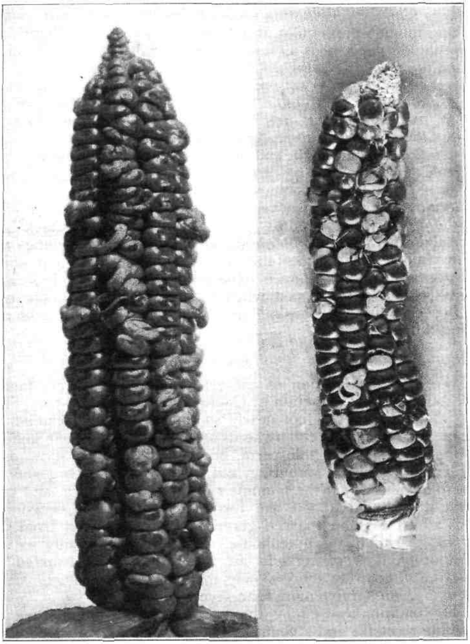

FIG. 74.—Two ears segregating for germinating seeds of the *ge*₁ type. Germination begins at an early stage. The ear at the right shows the apparent linkage between endosperm color and premature germination.

apparent at an earlier period because the recessive seeds are, with few exceptions, white, while the dormant seeds on the same ear are yellow. Eyster reports a similar association between pre-

mature germination and the absence of color in the endosperm and explains this on the basis of close linkage. Evidence presented later suggests that this may not be the true explanation, but the fact remains that the germinating seeds of this type are almost always lacking in endosperm color at all stages and can be distinguished from the dormant seeds as soon as the latter begin to show color. When the seeds have reached the late milk stage, germination has proceeded to a marked degree. The plumule, though well developed, is often unable to burst the pericarp because the endosperm is still soft and no pressure is provided. Instead it winds aimlessly around the endosperm, giving the seed a peculiarly swollen appearance. Later, as the endosperm tissues harden, many of the plumules are able to rupture the seed coat and, often, well developed roots and shoots are formed.

Germinating seeds, removed from the ear and grown in sand in the greenhouse, produce only albino seedlings which are very abnormal in appearance and soon die. If such seedlings are grown in complete darkness they develop a faint green color which disappears immediately upon exposure to full light. The faint green color is also formed when the seeds remain on the ear, well covered by heavy husks, but disappears when the husks are stripped down.

ge_2

Premature germination of the type caused by the ge_2 factor was found in an inbed strain of Golden Bantam sweet corn. This type of germination is not nearly so complete as that caused by the ge_1 factor. The recessive seeds are recognized by their smaller size and pale yellow endosperm, but not all of them show well marked indications of sprouting, and only occasionally is germination so advanced that the plumule ruptures the pericarp, and primary or secondary roots are formed. When these occasional seeds which do show marked germination are removed from the ear and grown in the greenhouse, they develop normally so far as chlorophyll is concerned, but are considerably dwarfed in appearance, growing more slowly than normal seedlings. Only a few of them survive more than several weeks.

The condition caused by the ge_2 factor is also inherited as a simple recessive and a count of seven ears segregating for this character is given in Table 22.

TABLE 22. Segregation of Dormant and Germinating Seeds in Stocks ge_1, ge_2, ge_3 and ge_4.

Type	No. of Ears	Total	ge	Ex. 3:1	Dev.	P. E.
ge_1	8	2220	528	555	—27	13.8
ge_2	7	1928	509	482	27	12.8
ge_3	[illegible]	446	99	112	—13	6.2
ge_4	[illegible]	169	44	42	2	3.8

ge_3

In 1924, Dr. Lindstrom very kindly furnished the writer with seed of his strain which had been segregating for germinating seeds. In some respects this type of premature germination, designated as ge_3 in this series, is almost identical to ge_1. The germinating seeds are white, with few exceptions, while the dormant seeds have a deep yellow color so characteristic of the Golden Bantam variety. The plumules produced by the germinating seeds are, like those of ge_1, albinos. They differ from the latter, however, in failing to form the faint tinge of green which characterizes the ge_1 seedlings under certain conditions.

The processes of germination in the ge_3 seeds evidently begin earlier and proceed further than in ge_1 seeds. When the dormant seeds are mature, the endosperm of the germinating seeds is almost completely exhausted and the pericarp is little more than an empty shell containing the withered remains of the partly grown seedling. This character is inherited as a simple recessive as indicated by the counts of the seeds from four ears shown in Table 22.

ge_4

Germinating seeds were noted on an ear of an eight-rowed, yellow flint variety of the Longfellow type, received from Mr. T. B. Macaulay of Montreal, Canada. No count of the seeds was made on the original ear which was thought to be open-pollinated. When the dormant seeds from this ear were grown and the plants self-pollinated, segregating ears were again obtained. The proportion of dormant to germinating seeds on one of these ears is given in Table 22.

Germination in this stock does not begin until the seeds are fairly hard. The premature germination is not associated with absence of color in the endosperm as in the three stocks already described, nor are the seedlings albinos as in the case of ge_1 and ge_3. Germinating seeds of this type, when removed from the ear and planted in the greenhouse, produce seedlings which are almost normal in appearance. By growing a large number of such seedlings it might be possible to mature a few homozygous plants in the greenhouse during the winter months. This stock, however, is the only one in which there seems to be any possibility of ever attaining a homozygous condition.

ge_5

This factor evidently arose as a mutation in either the ge_1 or ge_3 stocks. A cross between these two stocks, in addition to giving the expected 9:7 and 3:1 ratios, also produced a few progenies in which the ratio was clearly 27:37, as the figures in Table 24

indicate. Evidently three factors for germinating seeds instead of two were involved in this cross. It is not known which of the parental stocks contributed the third factor but it seems fairly certain that it arose in one or the other by recent mutation, since both strains had previously given only mono-hybrid ratios and a later generation has done the same.

This new factor is almost identical to ge_3 in its effect. The recessive seeds are completely lacking in endosperm color and the sprouts are entirely without chlorophyll. The two types cannot be distinguished from each other but both are separable from ge_1 for a brief period during which the faint green color is visible in the sprouts of the latter.

DESCRIPTION SUMMARIZED

The chief characteristics of these five types of germinating seeds may be briefly summarized as follows:

Type	Approximate Time Germination Begins	Color of Endosperm	Color of Plumule
ge_1	late milk	white	white (green tinge)
ge_2	dough	pale yellow	green
ge_3	early milk	white	white
ge_4	hard dough	yellow	green
ge_5	early milk	white	white

It should be emphasized that all these stocks are genetically yellow in their factors for endosperm color and genetically green with regard to seedling color. The absence of endosperm and chlorophyll color is apparently due to the physiological effects of premature germination.

All these characters are fully as lethal in their effect as the defective seeds described in Part I. Under field conditions the growing seedling dies as soon as the plant matures and the moisture supply is cut off.

PHENOTYPICAL AND GENETIC DIFFERENCES

The breeding program with these five types of premature germination involves crossing them in all combinations. Only seven of the ten possible crosses have so far been made, but the distinct phenotypical differences between several of the types almost precludes the possibility that they are genetically alike, and a tentative conclusion has been reached that all five are probably genetically distinct.

It is noted that the types fall into two distinct classes with regard to plumule color, ge_1, ge_3, and ge_5 producing white sprouts, ge_2 and ge_4 producing only green plumules. That the first three

are genetically distinct is shown by the 27:37 ratios given in Table 24. The ge_2 and ge_4 types are considered to be distinct from the remaining three because of the marked phenotypical differences between the two groups, and crosses which have so far been made confirm this assumption. The cross between ge_2 and ge_4 has not yet been made and though these two differ in the amount of endosperm color, the time at which germination begins, and the vigor of the seedlings, these differences are all of degree and might result from the action of modifying factors. There

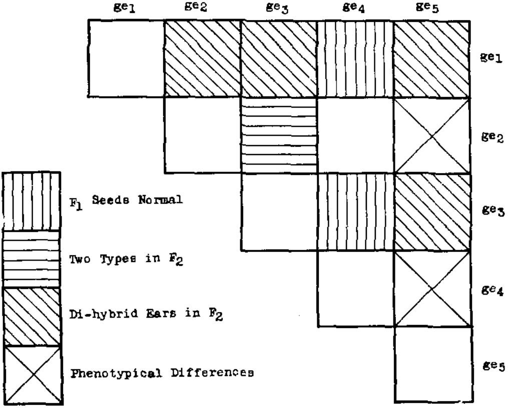

FIG. 75.—Diagram showing the crosses which have been made among the five stocks in which complimentary factors governing premature germination are involved.

remains the possibility, therefore, that ge_2 and ge_4 are genetically identical.

The situation with regard to these five types is shown in Figure 75. Squares with vertical cross hatching represent crosses in which the F_1 seeds are dormant and the F_2 has not yet been grown. Those with horizontal cross hatching indicate the combinations in which both types were recovered in F_2 although no di-hybrid ears were obtained. Diagonal cross hatching represents crosses in which di-hybrid ratios were found in F_2, while two intersecting diagonal lines indicate marked phenotypical differ-

ences between the types. The crosses in which di-hybrid ears were obtained are given in detail in Tables 23 and 24.

TABLE 23. Ears Segregating for Both Factors in the F_2 Endosperm Generation of a Cross of ge_1 and ge_2.

Ear No.	Dormant	Germinating
711	149	99
712	139	112
713	146	118
714	168	130
Total	602	459
Ex. 9:7	597	464
Dev. 5		
P. E. 10.9		

TABLE 24. Mendelian Ratios Occurring in the F_2 Endosperm Generation of a Cross Involving ge_1, ge_3 and ge_5.

Ear No.	Dormant	Germinating	Types Involved	Ratio Expected
2037	172	57	ge_1	3:1
2038	230	78	ge_1	"
2040	216	22	ge_1	"
Total	618	157		
Ex. 3:1	582	194		
2039	122	105	ge_3, ge_5	9:7
2041	165	124	ge_3, ge_5	"
2042	190	129	ge_1 and ge_3 or ge_5	"
2043	131	83	ge_3, ge_5	"
2044	212	127	ge_3, ge_5	"
2045	184	126	ge_1 and ge_3 or ge_5	"
2046	128	113	ge_3, ge_5	"
2047	171	128	ge_3, ge_5	"
Total	1303	935		
Ex. 9:7	1259	979		
2048	91	178	ge_1, ge_3, ge_5	27:37
2049	137	184	ge_1, ge_3, ge_5	"
2050	94	125	ge_1, ge_3, ge_5	"
Total	322	487		
Ex. 27:37	341	468		

The evidence so far as it goes indicates that these five types are all different and that the plant must be homozygous for the dominant allelomorphs of all five factors in order for all of its seeds to remain dormant until maturity.

DUPLICATE FACTORS

Premature germination due to the action of duplicate factors was first found on the F_3 ears of a cross between two strains of

Canada Flint which had been inbred for four generations. Germinating seeds had never been noted in either of these inbred strains nor did they appear among the F_1 crossed seeds. When the F_1 plants were grown, however, a number of the ears bore germinating seeds, scattered at random over the inflorescence. These ears were open-pollinated, and no attempt was made to determine the ratio in which the segregation occurred. Dormant seeds from one of these ears were grown and five self-pollinated ears were obtained. Three of these were clearly segregating in a 3:1 fashion. The fourth deviated from a 3:1 ratio by an amount equal to ten times the probable error, but exactly fitted a 15:1 ratio. The counts on these ears are arranged in Table 25.

TABLE 25. *Segregation of Dormant and Germinating Seeds when Duplicate Factors* ge_6 *and* ge_7 *are Involved.*

Ear No.	Dormant	Germinating	Ratio	Nearest Mendelian Ratio	Deviation from Nearest Ratio
2171	123	46	2.7:1	3:1	1.1 times P. E.
2172	104	31	3.4:1	3:1	.9 " "
2173	121	43	2.8:1	3:1	.5 " "
2174	230	15	15.3:1	15:1	.1 " "

The appearance of germinating seeds in the second generation of a cross between strains which had never previously shown these characters and the 3:1 and 15:1 ratios obtained in F_3 can be explained by assuming a pair of duplicate factors, one of which was contributed by each of the inbred strains. These factors are given the symbols ge_6 and ge_7 and the following genetic constitution of the parents and F_1 plants is suggested:

Parents	F_1 Plants
$Ge_6Ge_6ge_7ge_7$	$Ge_6ge_6Ge_7ge_7$
$ge_6ge_6Ge_7Ge_7$	

The F_1 plants when selfed should give 15:1 ratios. Whether or not they did could not be determined because the ears were all wind-pollinated. The dormant seeds from these plants should, when grown, give three types of progenies; (1), non segregating, (2), segregating 3:1, (3), segregating 15:1. Had the F_1 plants been selfed these three types of progenies would be expected in the ratio of 7:4:4 respectively. The non-segregating ears would be expected when one or both of the recessive factors is lacking; 3:1 ratios should occur when the plant is homozygous for one and heterozygous for the other, while the 15:1 ratios are expected on plants which are heterozygous for both factors.

It is noted that all three types of progenies have been obtained although the number of selfed ears examined is too small to determine in what proportions the various types are appearing.

Apparently the two factors involved in this stock are independent. Linkage would be indicated by a distortion of the 15:1 ratio, an excess of recessives being expected in the coupling phase, a deficiency in the repulsion phase.

Premature germination in this stock is somewhat similar to that caused by ge_2. The plumules are green but the endosperm color, instead of being pale yellow throughout, is affected only in the regions adjacent to the embryo. The endosperm color of the dorsal sides of the seed is, in most cases, full yellow.

RATIOS OF 8:1 AND 41:1

Another stock in which the action of duplicate, or perhaps triplicate, factors is suggested is the result of pollinating a chimera plant which appeared in the third generation of inbreeding in a strain of Sanford White, with pollen from an unknown yellow stock. The chimera had produced a pure white ear shoot and it was desired to obtain both selfed and crossed seeds from this plant. Accordingly pollen from an F_1 hybrid of two inbred strains of yellow flint corn was applied, but unfortunately no record was made of the row from which the pollen was taken and it is not known whether this particular hybrid had ever produced germinating seeds. It is known, however, that the inbred strain of Sanford White in which the chimera appeared had never shown germinating seeds.

TABLE 26. Segregation of Dormant and Germinating Seeds when Duplicate Factors ge_8 and ge_9 are Involved.

Ear No.	Dormant	Germinating	Ratio	Nearest Mendelian Ratio	Deviation from Nearest Ratio
2178	165	4	41.3:1	15:1	3.1 times P. E.
2179	163	22	7.4:1	15:1	4.6 " "
2180	187	21	8.9:1	15:1	3.3 " "

Four self-pollinated ears were obtained from the yellow seeds produced by cross-pollination with the unknown pollen parent. Three of these segregated for germinating seeds and the counts on these ears are set forth in Table 26. Two of the ears gave ratios approximately alike, the proportion of dormant to germinating seeds being about 8:1. This ratio deviates from 3:1 by more than nine times the probable error and from 15:1 by 5.6 times the error. The third ear, No. 2178, gave a ratio of 41:1 which differs from a 15:1 by 3.1 times the probable error and from 63:1 by an amount equal to 3.2 times the error.

These results may be explained on the basis of linkage between the two members of a pair of duplicate factors. A ratio of 8:1 would be expected if the two genes were linked with crossing over of approximately 34 per cent. The same two factors in the

repulsion phase should give a ratio of 17:1. Ear No. 2178 may represent the repulsion phase since it deviates from the expected 17:1 ratio by less than three times the probable error.

It is also possible that three factors instead of two are involved. Plants heterozygous for two of these and homozygous for the third would be expected to give 8:1 ratios if the two heterozygous factors were linked with crossing over of 34 per cent. Plants heterozygous for all three, two of which are linked, should give 35:1 instead of 63:1 ratios. Ear No. 2178 fits such a ratio very closely. The data, however, are not sufficiently comprehensive to substantiate such an interpretation. If three factors are involved with 34 per cent crossing over between two of them, the following ratios are expected when dormant seeds from ear No. 2178 are grown; 3:1, 8:1, 15:1, 17:1, 35:1, and 71:1. Another season's results should show definitely whether duplicate or triplicate factors are involved.

Premature germination in this stock is similar to that caused by ge_4. Germination begins at a very late stage and the endosperm color is not greatly affected.

SUMMARY OF BREEDING BEHAVIOR

Tentatively, then, the genetic situation with regard to the stocks which have been studied may be outlined as follows:

ge_1, ge_2, ge_3, ge_4, ge_5 } Five single factors, any one of which in a homozygous recessive condition causes premature germination.

ge_6, ge_7 } A pair of independent duplicate factors which cause premature germination when both are present in the recessive condition.

ge_8, ge_9 } A pair of linked duplicate factors causing premature germination when both are present. Crossing over is about 34 per cent. A third factor in this set, ge_{10}, is also indicated.

LINKAGE RELATIONS

A detailed study of the linkage relations of these factors with other well known characters has not yet been undertaken. Data are available, however, to show the relation of the ge_1, ge_2, ge_3, and ge_5 genes with the factor for sugary endosperm. In all these cases the germinating seeds cannot be accurately classified with regard to endosperm texture and linkage must be detected by the distortion in the starchy : sugary ratio among the dormant seeds. In the repulsion phase the percentage of sugary seeds in

the dormant class should vary between 25 and 33⅓, depending on the intensity of the linkage. This is shown diagrammatically in Figure 63, Part I. In the coupling phase, linkage would be expected to cause a deficiency of sugary seeds in the dormant class, the percentage ranging from 25 to 0.

ge_1 *x* *Su*

The linkage relations of ge_1 with *Su* are determined from the cross between the ge_1 and ge_2 stocks. The former is a yellow flint variety, the latter a yellow sugary. Eight ears which were segregating for ge_1 were obtained from this cross and the proportion of sugary seeds in the dormant class on these ears is shown in Table 27.

TABLE 27. Starchy:Sugary Segregation in Dormant Seeds from Ears Segregating ge_1.

Ear No.	Starchy	Sugary	Percent Sugary
710	145	60	29.3
715	159	61	27.7
721	179	73	29.0
722	146	69	32.1
723	162	44	21.4
725	110	43	28.1
726	164	71	30.2
727	153	53	25.7
Total	1218	474	28.0
Ex. 3:1	1269	423	25.0
Dev. 51			
P. E. 12.0			

It is noted that there is an excess of sugary seeds, amounting to 4.25 times the probable error. Such a deviation would be expected by chance alone only once in about 250 trials. The excess, though it occurs in all but one of the eight ears, would not be regarded as significant if seeds from a smaller number of ears were counted. When all the ears are combined, however, the accumulation of small deviations is one direction results in a total deviation which can scarcely be attributed to chance. The excess of sugary seeds in this class can be explained by assuming linkage between the genes ge_1 and *Su* with approximately 40 per cent crossing over. It is realized, of course, that linkage values determined by the distortion in a single class necessarily have a large probable error and the value given must not be regarded as more than an approximation.

That the excess of sugary seeds in the dormant class is due to some relation with the ge_1 factor and not to errors in classification or to genetic factors affecting the rate of pollen tube growth, is further indicated by a count of the sugary seeds on eight ears

from the same cross which are not segregating for ge_1. On these ears the percentage of sugary seeds is very close to expectation and deviations are minus almost as frequently as plus, as is indicated in Table 28.

TABLE 28. *Starchy:Sugary Segregation in Ears Not Segregating ge_1 from Same Cross as Ears in Table 27.*

Ear No.	Starchy	Sugary	Percent Sugary
728	192	48	20.0
729	221	80	26.6
730	211	65	23.6
731	204	69	25.3
733	163	57	25.9
734	185	82	30.7
735	227	68	23.0
736	175	79	31.1
Total	1578	548	25.8
Ex. 3:1	1594	532	25.0
Dev. 16			
P. E. 13.5			

ge_2 x su

The relation of ge_2 and *su* is shown by ears from this same cross which are segregating for ge_2 and sugary but not for ge_1. The counts from seven such ears appear in Table 29. Linkage in this case would be indicated by a deficiency of sugary seeds since the two factors entered the cross in the coupling phase. Actually there is a slight but not significant excess of sugary seeds in the dormant class and it appears safe to conclude that ge_2 and *su* are independent.

TABLE 29. Starchy:Sugary Segregation in Dormant Seeds of Ears Segregating ge_2 from Same Cross as Ears in Tables 27 and 28.

Ear No.	Starchy	Sugary	Percent Sugary
705	121	44	26.7
706	172	59	25.5
707	146	67	31.5
708	158	52	24.8
716	134	41	23.4
717	155	54	25.8
718	152	64	29.6
Total	1038	381	26.8
Ex. 3:1	1064	355	25.0
Dev. 26			
P. E. 11.0			

ge_3 and ge_5 x su

Five of the ears represented in Table 24 are segregating for *su*, ge_3 and ge_5. The two types of germinating seeds cannot be distinguished but if either one is linked with sugary a distortion

of the starchy : sugary ratio in the dormant seeds would be expected. A count of the two types of seed in the dormant class on these five ears appears in Table 30. The agreement with expectation on the basis of independent inheritance is very good and it seems certain that both factors are independent of sugary.

TABLE 30. Starchy:Sugary Segregation in Dormant Seeds of Ears Segregating ge_3 and ge_5.

Ear No.	Starchy	Sugary	Percent Sugary
2039	99	23	18.9
2041	121	44	26.7
2043	96	35	26.7
2044	154	58	27.4
2046	99	29	22.7
2047	124	47	27.5
Total	693	236	25.4
Ex. 3:1	697	232	25.0
Dev. 4			
P. E. 8.9			

APPARENT LINKAGE WITH ENDOSPERM COLOR FACTORS

As has already been mentioned, there is a strong association between germinating seeds and absence of color in the endosperm. In the case of ge_1, ge_8 and ge_5 the recessive seeds are, with few exceptions, completely white, while in the ge_3 strain the germinating seeds are a pale yellow.

TABLE 31. Apparent Linkage between ge_1 and White Endosperm.

Ear No.	Yellow		White	
	Ge	*ge*	*Ge*	*ge*
710	204	1	1	66
715	219	0	1	56
721	252	1	0	67
722	213	1	2	74
723	205	0	1	62
726	234	0	1	61
754	205	0	1	74
Total	1532	3	7	460

Occasionally, however, germinating seeds with yellow endosperm are found as well as white seeds which have not sprouted The frequency of these exceptions in stocks 1 and 3 is shown in Tables 31 and 32. At first glance the situation represents a clear cut case of close linkage with less than 1 per cent of crossing over. Eyster (1924) has assumed this to be the situation in his stock and has calculated the amount of crossing over as 1.26 per cent. The writer (1923) had previously suggested physiological correlation as an explanation of these results and the evidenc

indicates that this is probably the correct interpretation in the stocks reported here.

There are at least three series of facts which are not compatible with a linkage hypothesis:

1. All of the stocks in which the association between premature germination and color of endosperm appears have originated from varieties which were homozygous for yellow endosperm. White seeds might be expected to arise occasionally by mutation, but the appearance of four genetically distinct factors for white seeds, each one closely linked with a factor for germinating seeds, cannot reasonably be assumed.

2. When pollen from plants which are segregating for germinating seeds is applied to silks of a white variety, only yellow seeds are produced. If the segregating plants were heterozygous for endosperm color, as they appear to be, such crosses should produce 1:1 ratios, providing that the white endosperm of the germinating seeds has the same genetic basis as the white endosperm of common white varieties.

3. The apparent cross overs, white seeds which fail to sprout, should breed true if it is assumed that they are homozygous for a recessive endosperm color factor. Only a small number of these seeds have been available but all those which were grown produced only plants segregating for white seeds which germinated, with few exceptions.

TABLE 32. Apparent Linkage between ge_3 and White Endosperm.

Ear No.	Yellow *Ge*	Yellow *ge*	White *Ge*	White *ge*
758	70	1	0	22
760	60	0	0	17
761	101	0	0	27
Total	231	1	0	66

If the association between germinating seeds and endosperm color is not due to linkage, to what may it be attributed? A histological study of the germinating seeds of the ge_1 stock has given evidence which seems to have some bearing on this question.

PREMATURE DIGESTION AND PIGMENT FORMATION

Some of the white seeds were removed from the ear at an early stage, killed and fixed, imbedded in paraffin, sectioned, and stained. It was found that even at this early stage the processes of germination had already begun. The cells in the epithelial layer of the scutellum had elongated and the invaginations of this layer, so characteristic of mature seeds of maize, were already apparent. Sargant and Robertson (1905) have made a thorough

study of the scutellum of maize and are of the opinion that these invaginations are glandular in nature and that their function is the secretion of diastase. There is some appearance of digestion in the cells of the endosperm of germinating seeds even at the early milk stage, and in material gathered from the same ears a week later, the digestion is quite marked.

It is possible that the normal production of color in the cells of the endosperm cannot proceed while digestion is occurring in these cells. The yellow color in the endosperm is found in the matrix which surround the starch grains, and if this matrix is being digested as rapidly, or more rapidly, than new material is being supplied by the plant, it is hardly to be expected that pigment formation would proceed in the normal fashion.

The apparent cross overs, the yellow seeds which germinate and the white seeds which remain dormant, may be merely variations of this condition.

Some of the germinating seeds probably remain yellow because the digestion does not begin soon enough or is not rapid enough to inhibit the formation of endosperm color. This would appear to be the case in the stock where the duplicate factors ge_6 and ge_7 are involved. In this stock the pale yellow is usually confined to an area adjacent to the embryo and the dorsal side of tbe seed retains the full yellow color.

The other class of apparent cross overs, the white dormant seeds, are more difficult to explain. The fact that all of these seeds which have ever been grown have given ears segregating for germinating seeds might suggest that this character occasionally manifests itself in the heterozygous condition.

THE RELATION OE PREMATURE GERMINATION TO CHLOROPHYLL DEVELOPMENT

Evidently there is also a physiological relation of some sort between premature germination and chlorophyll development. Types which begin germination at a very early stage, such as ge_3 and ge_5 always produce pure white sprouts. The ge_1 type, in which germination begins somewhat later, ordinarily produces white plumules but occasionally these show a tinge of green. The remaining types in which germination begins only after the kernels are well developed, produce only normal green sprouts. Apparently the premature germination, if it begins early enough completely inhibits the formation of chorophyll just as it prevents the laying down of yellow pigment in the endosperm.

This association, too, is characterized by occasional exceptions. Germinating seed of ge_1, ge_3 and ge_5 are sometimes found which produce sprouts of normal green color, but dormant seeds which give albino seedlings when germinated have never been observed

PHYSIOLOGY OF PREMATURE GERMINATION

Oppenheimer (1922) has found that in seeds of tomato, gourd, cucumber and *Nicotiana rustica*, germination can be suppressed by surrounding the seeds with crushed tissue of the receptacles of the mother plants or by growing them on filter paper saturated with an extract from these tissues.

The degree of suppression is approximately proportional to the amount of tissue present or the concentration of the extract. This suppression can be overcome by heating the tissue or extract to 100° C. Apparently the mother plants of these species normally supply the growing seed with inhibiting substances which prevent germination while the seeds are still attached to the plant. Mazé (1910) is of the opinion, and presents some evidence in favor of his view, that dormancy in seeds, buds, bulbs, and tubers is due, in some cases, to the action of volatile esters which prevent growth until they are eliminated.

Oppenheimer did not include seeds of maize in his experiments but a test made by the writer, in an effort to determine at what stage of development germination in the normal seed still attached to the plant could be induced, may have some bearing on the problem. An ear in the early milk stage was stripped down and wrapped with cotton. Around this were wrapped several layers of cloth. The ends of the cloth were submerged in a vessel of water and served as a wick, keeping the cotton surrounding the ear constantly saturated. The grains swelled considerably, indicating that water was being absorbed, but no germination occurred. A number of seeds which had been removed from this ear and placed in an ordinary germinator at approximately the same temperature and with the same moisture supply, began to sprout after about ten days. This is much longer than the time required by immature, dry seeds to germinate under the same conditions and indicates that inhibiting substances were first eliminated before germination could begin.

THE EFFECTS OF PREMATURE GERMINATION ON THE GROWTH OF THE SEED

An attempt was made to determine whether the germinating seeds receive the normal amount of nourishment from the plant while germination is going on or whether these seeds cease their development after germination begins. Ears which were segregating for germinating seeds (ge_1) were harvested at three weeks after pollination, and at intervals of one week thereafter, until maturity. These ears were dried on a rack until thoroughly dry, at which time the kernels were shelled off, the dormant and germinating seeds separated, counted and weighed, and the average weight of each class determined by simple division. The results

are shown in two curves in Fig. 76. It will be seen that already in the early milk stage there was a noticeable difference in the relative development of the two types as represented by their dry weights. This difference increased in the second week under observation and thereafter the germinating seeds no longer increased in weight and actually fell off somewhat during the last

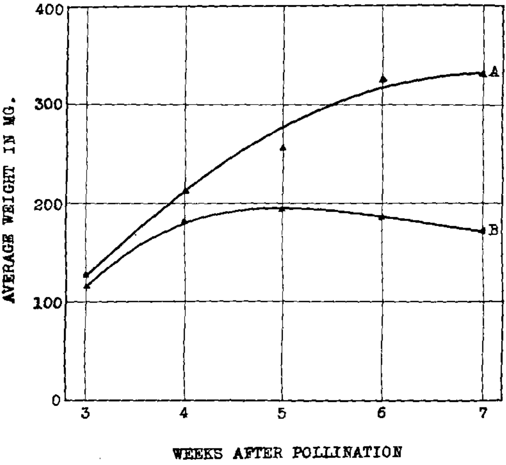

FIG. 76.—Growth curves of dormant and germinating (gc_1) seeds from the same segregating ears. The sprouting seeds do not receive enough nourishment from the plant to replace the material lost in germination.

three weeks. The normal seeds on the same ears showed an increase in dry matter during every week of the test. It is evident from these two growth curves that the amount of nourishment supplied to the aberrant seeds by the plant is not sufficient to replace that consumed in germination. In fact, it is quite likely that the germinating seeds become partially or wholly "physiologically isolated" from the plant during the later periods. At maturity the germinated seeds weighed only 51 per cent as much as the dormant seeds from the same ears.

DISCUSSION

For a period of several weeks, while the seed is in the milk or dough stage, natural conditions for germination are almost at an optimum. The temperature is fairly high and the moisture supply is abundant. The embryos are sufficiently developed to produce plants capable of surviving and the endosperm contains enough food material to nourish the seedling until it begins to manufacture food for itself. That this is true is shown by the behavior of immature seeds harvested at these early stages when many of them are capable not only of germinating but of producing almost a normal yield of grain. (See Part I.)

Why is it, then, that the partially developed seed ordinarily never germinates while still attached to the plant? Apparently the mother plant, though it provides conditions suitable for germination, at the same time supplies inhibiting substances which prevent germination from beginning.

The physiological processes involved in maintaining a period of dormancy, which permits the embryo to attain a maximum development and the endosperm to accumulate a mass of food material, are probably very complicated. It is not at all surprising, therefore, to find a number of distinct genetic factors operating during this period. Every stage in the ontogeny of the sporophyte is evidently controlled by many genetic factors and the maintenance of a normal period of dormancy which prevents premature germination with its disastrous effects, and permits the sporophyte to pass safely through unfavorable seasons, is no exception. Nine Mendelian factors which govern this stage have already been identified. Many others will undoubtedly be found as maize is investigated more extensively.

SUMMARY—PART IV

1. Nine Mendelian factors involved in the maintenance of a normal period of dormancy in maize seeds have been identified.

2. Five of these are complementary factors. When any one of these is lacking the seed germinates prematurely. Plants heterozygous for one, two or three factors give 3:1, 9:7, and 27:37 ratios respectively.

3. A pair of independent duplicate factors results in ratios of 15 dormant: 1 germinating when plants are heterozygous for both.

4. A pair of linked duplicate factors gives 8:1 ratios when plants are heterozygous for both. Crossing over is about 34 per cent.

5. The ge_1 factor appears to be linked with the gene for sugary endosperm. Crossing over is about 40 per cent. ge_2, ge_3 and ge_5 are found to be independent of sugary.

6. An apparent case of close linkage between endosperm color and several types of germinating seeds is probably due to the physiological effects of premature germination upon the accumulation of pigment in the cells of the endosperm.

7. A similar association between germinating seeds and white seedlings may also be due to physiological complications. Seeds which germinate at early stage produce only white plumules; those which germinate later have normal green sprouts.

8. Premature germination is apparently caused by the lack or loss of inhibiting substances normally supplied by the plant to the growing seeds.

9. It is suggested that many genetic factors are involved in the maintenance of a normal period of dormancy in maize seeds.

Conclusion

The mature, dormant seed of maize with its well developed embryo and the cells of its endosperm packed with starch grains, represents a real organic achievement.

Each ovule has its separate style; each style, in order for a seed to develop, must receive a pollen grain capable of germinating and producing a tube sufficiently vigorous to reach the micropyle. Failure of the growing tube to attain its goal results in the production of "parthenocarpic" defectives without endosperm or embryo.

After the pollen tube has entered the micropyle, a very precise mechanism of fertilization begins to function. Failure of this intricate mechanism in any detail may cause the formation of "germless" seeds, lacking an embryo, "miniature" seeds in which the endosperm is greatly reduced in size or perhaps aborted seeds of several other types.

The fertilization mechanism having functioned properly, the growing seed begins to receive the influence of various genetic factors. Thirteen distinct factors have been found which arrest the development of the seed and cause it to be defective and incapable of normal growth and germination. Five additional factors may affect the nature of the stored food material to such a degree that the seed is handicapped and cannot attain a maximum development.

In addition to the 18 genetic factors so far found which *retard* development to a greater or lesser degree, nine other factors have appeared which *stimulate* certain functions prematurely, with equally disastrous consequences. The seed, in order to reach maturity and pass safely through unfavorable seasons must remain dormant while still attached to the plant, even though it is capable of germination at this stage and the conditions favoring germination are almost optimum. Five complementary factors

and two pairs of duplicate factors are involved in the maintenance of dormancy during development. The loss of any one or pair of these causes the seed to germinate prematurely with fatal results.

A fully mature, normally developed, dormant, white, starchy seed, then, represents the cumulative action of 27 Mendelian factors of which we know the mode of inheritance. How many additional factors are involved would be difficult to estimate, but since all these permanent departures from the normal condition of the germplasm have been found in a limited amount of material, it is certain that many more hereditary factors of a similar nature will appear. This gives some clue as to the infinitely large number of genes always working to produce a normal seed. The majority of these can not be known because they do not vary.

All hereditary units here studied concern only the seed which comprises a brief period betweeen fertilization and the resting stage of the embryo. What, therefore, must be involved in the ontogeny of the entire plant? The young seedling, the growing plant, the chlorophyll processes, reproductive machinery and even the gametophyte generation are all controlled by genetic factors the tabulation of which has only been started.

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EXPLANATION OF PLATES.

PLATE XXI. Longitudinal sections of normal seed and three successive stages of development of defective seeds of de_{11} stock. x 11.

1. Normal seed at early milk stage.
2. Defective seed, early milk.*
3. Defective seed, late milk.
4. Defective seed, dough.

PLATE XXII. Three successive stages in development of defective seeds of the de_3 stock. x 11.

1. Defective seed, early milk.
2. Defective seed, late milk.
3. Defective seed, dough.

PLATE XXIII. Three successive stages in development of defective seeds of the de_5 stock. x 11.

1. Defective seed, early milk.
2. Defective seed, late milk.
3. Defective seed, early dough.

PLATE XXIV. Successive stages in the development of the normal embryo. x 15.

1. Blister stage.
2. Early milk.
3. Milk.
4. Late milk.
5. Dough.

PLATE XXV. 1. Ears of a uniform first generation hybrid harvested at successive stages of maturity. From left to right the ears represent stages of 14, 21, 28, 35, 41, 51 and 75 days after pollination.

2. Fifty seeds from each of the ears. In appearance and dry weight these normal seeds harvested at successive stages of development resemble various types of hereditary defectives.

3. The results of planting the fifty seeds shown in 2. In ability to germinate the immature normal seeds are superior to hereditary defectives of the same relative development.

PLATE XXVI. Four morphologically distinct types of seeds which may occur on any ear of maize. x 11.

1. Normal seed with well developed endosperm and embryo.
2. Hereditary defective with aborted endosperm and embryo.
3. Germless seed containing endosperm but no embryo. This type is probably due to single fertilization.
4. Parthenocarpic defective with neither endosperm nor embryo. This type is caused by pollination which fails to accomplish fertilization.

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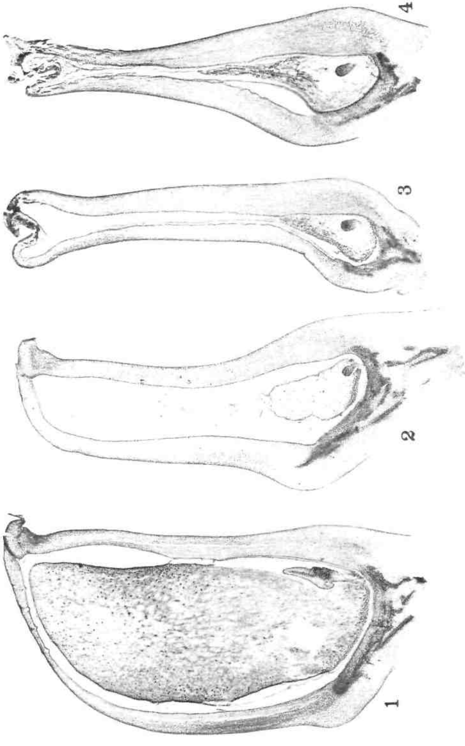
* The relative stage of development, in every case, is that of normal seeds from the same ear, and not of the defectives themselves.

PLATE XXI.



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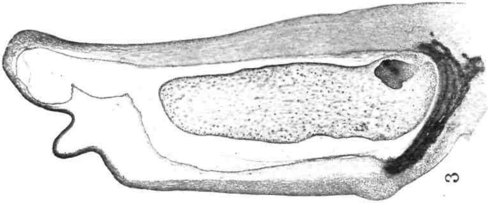

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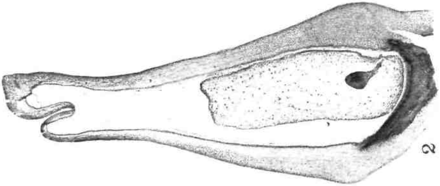

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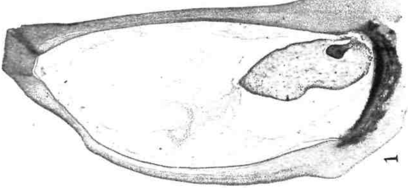

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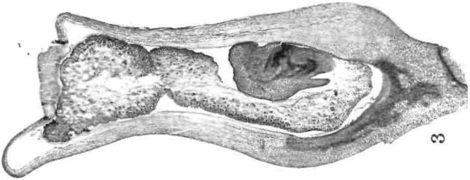

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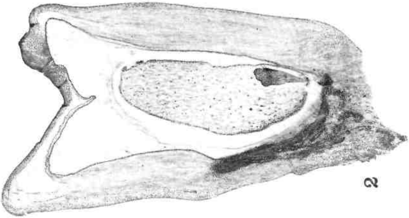

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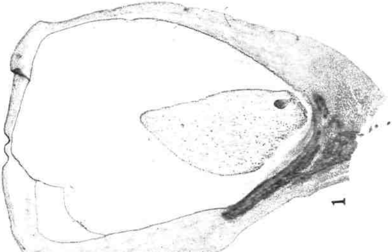

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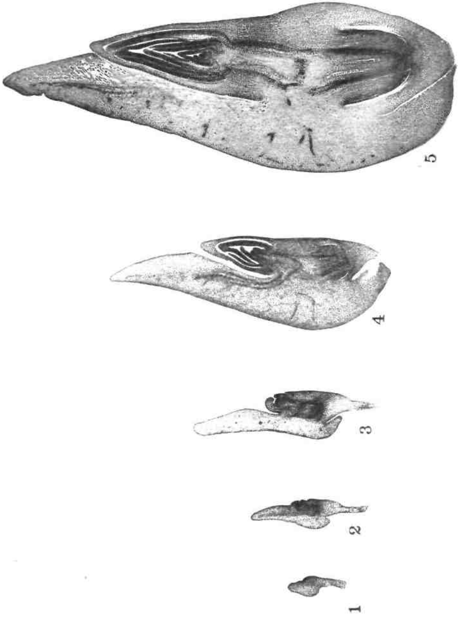
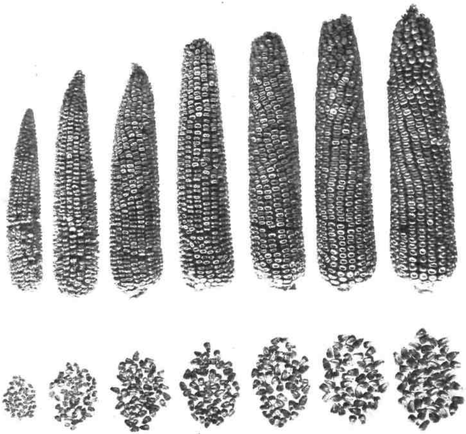
PLATE XXIV.





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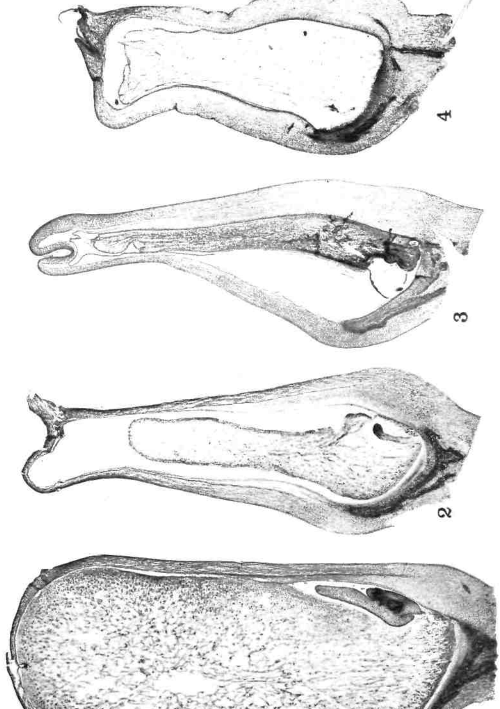

BULLETIN 280 JULY, 1926

Connecticut Agricultural Experiment Station

New Haven, Connecticut

1875 - 1925

SEMI-CENTENNIAL

OF THE

Connecticut Agricultural Experiment Station

The Bulletins of this Station are mailed free to citizens of Connecticut who apply for them, and to other applicants as far as the editions permit.

SEMI-CENTENNIAL

of the

Connecticut Agricultural Experiment Station

1875-1925

Seventy-five years ago Samuel W. Johnson began his labors in the interest of American agriculture. Through his contributions to the agricultural press, his early analyses of fertilizers to expose frauds, his addresses before agricultural societies, he soon became a leader, especially in Connecticut, where he labored to improve the status of the farmer and bring to him the teachings of science. During these early years he never lost an opportunity to urge the need of research and the propriety of maintaining an agricultural experiment station at public expense. In 1875, after twenty years of constant effort, Professor Johnson saw the fruit of his labors in the establishment of this station. It seemed appropriate, therefore, that the semi-centennial of this station, which marks the passage of fifty years in experiment station history in this country, should be fittingly recognized.

The announcement on the next page was sent to all experiment stations, to many scientific institutions and societies in this country and abroad and to the citizens of Connecticut. Following this will be found a brief history of the station, its establishment and government, its growth and some of its outstanding accomplishments. There are also included the two principal addresses delivered on this occasion, and reproductions of the portraits and memorials presented to the station at that time.

THE BOARD OF CONTROL

OF THE

CONNECTICUT AGRICULTURAL EXPERIMENT STATION

INVITE YOU TO BE PRESENT

AT THE EXERCISES TO BE HELD ON THE

TWELFTH DAY OF OCTOBER

NINETEEN HUNDRED AND TWENTY-FIVE

AT

NEW HAVEN, CONNECTICUT

IN CELEBRATION OF THE

FIFTIETH ANNIVERSARY

OF THE FOUNDING OF THE STATION

HISTORICAL SKETCH

OF

THE STATION

The Connecticut Agricultural Experiment Station dates its birth early in 1875. At that time the General Assembly, voting that the Trustees of Wesleyan University at Middletown had tendered "the free use of laboratory and other facilities for establishing and carrying on an Experiment Station for the general benefit and improvement of agriculture and kindred interests of the State of Connecticut," appropriated $2,800 a year for two years for its support. Prof. W. O. Atwater of Wesleyan University was chosen director.

With very limited means at its disposal the Station's efforts were chiefly directed to the examination of commercial fertilizers and the study of their adaptation to special local requirements. But the director saw clearly the real purpose of an agricultural station, declaring that "it will be worthy of the name in proportion as it carries on accurate and thorough investigation and experiment in agricultural science."

The usefulness of the Station was made so apparent that at the end of the two year period the State resolved to establish it as a separate and independent State institution. This was done by an act of incorporation approved March 21, 1877. The Station's purpose was declared to be, "To promote agriculture by scientific investigation and experiment." Five thousand dollars were appropriated for its annual support and it was placed at New Haven.

Unlike other stations, afterwards organized, it is not connected with any other institution and has the corporate rights to receive and hold real and personal property and to sue and be sued in courts. It is managed by a Board of Control of eight members, one each appointed by the State Board of Agriculture, the State Agricultural Society, Wesleyan University and the Sheffield Scientific School and two by the Governor. The Governor of the State and the Station director are *ex-officio* members. Of the original members four were leading farmers, one an agricultural editor and one a professor in the State Agricultural College. Prof. S. W. Johnson was chosen director.

The Station for a time occupied an office and laboratory in the Sheffield Scientific School given by the School for its use without charge, but in 1882 the General Assembly provided a permanent home in New Haven, which the Station has occupied ever since, with about six acres of land, a dwelling house and barn. A laboratory was also built for its use.

WILBUR O. ATWATER, PH.D., LL.D.

First Director, Connecticut Agricultural Experiment Station, 1875-1877.

Graduated from Wesleyan University (A.B.), 1865; graduate student, Yale University (Ph.D.), 1869, Leipzig and Berlin, 1869-1871; Professor of Chemistry, Tennessee, 1871-1873; Maine State College, 1873; Wesleyan University, 1873-1907; First Director, Storrs Agricultural Experiment Station, 1888-1902; Founder and Director, Office of Experiment Stations, United States Department of Agriculture, 1888-1891; Established the series of United States Farmers' Bulletins, 1889; Special Agent, Nutrition Investigations, 1891, Chief in 1893, and until some three years before his death carried on the long series of dietary studies and investigations with the respiration calorimeter; Honorary LL.D., University of Vermont, 1904; Recipient of the Elliot Cresson gold medal of the Franklin Institute, and gold medal from the Paris Exposition in 1900, and other medals. Fellow, American Association for the Advancement of Science; member American Chemical Society, American Physiological Society, Washington Academy of Sciences, and of many foreign societies. Born, Johnsburg, N. Y., May 3, 1844. Died, Middletown, Conn., September 22, 1907.

(Illustration by courtesy of the Wesleyan University Alumni Association.)

Since then the Station has acquired from the income of the Lockwood fund, to be noticed later, an experiment field and orchard of 35 acres at Mt. Carmel; 13 acres of land with barns, sorting and fermenting rooms and a small greenhouse for tobacco experiments at Windsor;* tracts of 150 acres in Windsor and Granby and 4 acres in Enfield for experiments in forestry.

On the Station land in New Haven have been built, as the need developed, greenhouses, a large fireproof laboratory (the Johnson Laboratory) accommodating most of the departments, a smaller laboratory for the soils work and the plant breeding department and various small buildings for storage, etc. The original chemical laboratory has been made over for a library.

The steady growth and diversification of the Station's work, as they were made possible by appreciation of its service and by federal and state appropriations, may be indicated as follows:

From the beginning, studies of fertilizers, seeds, feeding stuffs, of analytical methods were carried on. In 1882 began investigations in the interest of dairying; the examination of foods in 1885, a food law being passed in 1895; of drugs in 1907; a department of economic botany was organized in 1888; investigations of the protein bodies followed in 1890. A department of horticulture, soon becoming entomology, was established in 1896; of forestry in 1901; of plant breeding in 1905 and of soils in 1923.

The Station has also been charged with much control work by special statutes. For instance, the fertilizer control; the control of foods and drugs, in coöperation with the Dairy and Food Commissioner; nursery and orchard inspection; control of insect and fungous pests, in immediate charge of the State Entomologist and Botanist, both members of the staff; the work of mosquito elimination; blister rust eradication; and apiary inspection.

For years the State forester was also a member of the staff. The Station forester, entomologist and botanist are an examining board to examine and certify those who are qualified to practice remedial treatment of trees outside their home towns.

What has the Station accomplished in these fifty years? It is impossible here to answer in detail. The few items mentioned below can only serve as examples of its work. It should be remembered that at its beginning there was no telephone exchange in the state, no radio, no trolley service, no automobile, no hardened state roads. No one knew definitely about the nitrogen-fixing habits of the legumes or the control of insects and fungous diseases; there was not a spraying outfit in the state, nor a silo.

There was no efficient grange organization. The only farmers' gathering of importance, outside of local farmers' clubs, was the annual meeting of the State Board of Agriculture.

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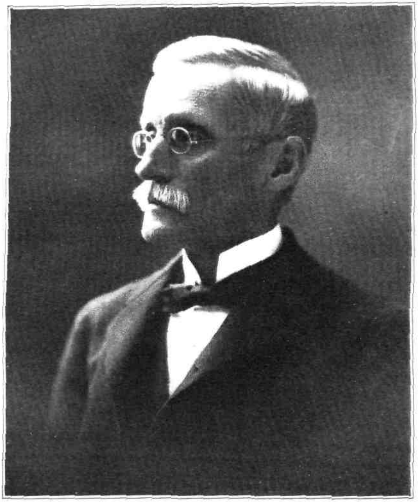
* These last with the help of an association of tobacco dealers and growers.



SAMUEL W. JOHNSON, M.A.

Director, Connecticut Agricultural Experiment Station, 1877-1899.

Student, Yale University, 1849-1850; Instructor in Chemistry, Physics and Human Physiology, State Normal School, Albany, N. Y., 1851-1852; Student, Leipzig, 1853-1854, Munich, 1854-1855; Honorary M.A., Yale University, 1857; Professor of Agricultural Chemistry, Yale University, 1856-1896; Emeritus, 1896; Associate Editor, *American Journal of Sciences*, 1869-1880; member National Academy of Sciences, American Academy of Arts and Sciences, Society for the Promotion of Agricultural Science, and American Chemical Society, of which he was president in 1878. Author of "How Crops Grow," 1868, translated into six other languages; "How Crops Feed," 1870, translated into four other languages. Born, Kingsboro, N. Y., July 3, 1830. Died, New Haven, Conn., July 21, 1909.

In its early days the Station staff was its own "Extension Service" and went wherever its members could get a hearing, explaining its work; sometimes using its bulletins as a text, often greatly encouraged and sometimes saying with the prophet, "Who hath believed our report?" Personal relations with farmers and the give and take of the discussions which such gatherings made possible established a helpful relation and mutual understanding which made an enduring basis for the Station's usefulness.

Some illustrations of its work, as set forth in a History of Connecticut, are the following:

"It taught and proved by field trials the value of spraying for the protection of field crops and orchards from fungi and insects.

It has studied the life history of each new insect and fungus pest as it has appeared and the best methods of fighting it: the San José scale, the gypsy moth, the pine blister rust, the elm leaf beetle, etc. It has directed the work of mosquito elimination and accomplished much with the insufficient means at its disposal.

It substituted for the very unfair method of payment of cream by the space, the Babcock method of determining and paying for butter fat only, by adapting it for cream gathering creameries and proving its value.

It made, at the request of dairymen, a comparison of economy between the gravity and the separator systems of raising cream for butter-making creameries.

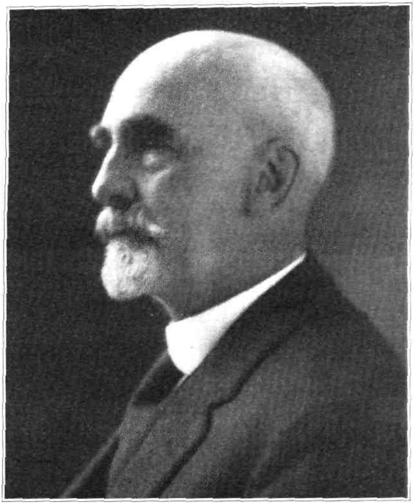
By its inspection and reports it has exposed the frauds in foods and fertilizers and driven most of them out of the State before the Federal Government undertook any of that work. As a part of that work it has examined all the special foods made and recommended for diabetic patients and the reports on them are the standard reference for specialists in the treatment of this disease.

The long continued and fruitful researches of Dr. Osborne have identified and showed the ultimate and structural composition and properties of the principal vegetable proteins.

An inquiry into their relative nutritive value led to extensive studies in nutrition, has perfected a new and most fruitful method of experiment in this field, has led to the discovery of vitamines and studies of their function and to medical studies on the cause of rickets, infertility, etc.

The study of plant breeding here has shown the futility of certain recommended methods of breeding and selection and by methods first adopted here has produced new and improved strains of corn and tobacco and has demonstrated methods of developing superior strains of field crops which have secured general recognition.

It introduced into the State the successful growing of shade tobacco and the method of fermentation in bulk and by its very elaborate field tests with fertilizers has greatly advanced the tobacco-growing industry in the State.



EDWARD H. JENKINS, PH.D.

Director, Connecticut Agricultural Experiment Station, 1900-1923; Emeritus, 1923.

Director, Storrs Agricultural Experiment Station, 1912-1923; graduated Yale University (A.B.), 1872; graduate student at Leipzig, 1875-1876, and then at Yale, receiving the Ph.D. in 1879. Chemist, Connecticut Agricultural Experiment Station, 1877-1900, Vice Director, 1884-1900, Treasurer, 1901-1923; Chairman, Connecticut State Sewerage Commission, 1897-1903; Charter member and President, Association of Official Agricultural Chemists and member of its first Committee on Food Standards; President, 1913. Association of American Agricultural Colleges and Experiment Stations; Fellow, American Association for the Advancement of Science; member, Society for the Promotion of Agricultural Science; Author of Agriculture in Osborn's History of Connecticut, 1925. Born, Falmouth, Mass., May 31, 1850, now lives at 108 East Rock Road, New Haven, Conn.

The station established an experimental forest for the study of forest problems, aided in the planting of private and corporation forests, besides giving advice by addresses and field demonstrations in the management of the farmer's wood lot.

These illustrations, by no means a summary, give some idea of the range of the station's work and show how it has gradually become a public service agency. While designed solely for the benefit of agriculture and while its main effort is directed to that end, circumstances have drawn it in several directions into the service of the whole community."

The State has increased appropriations to the Station from time to time, as its necessities required and the contributions made by the Federal government, one-half of which go to this Station, are known to all.

Important individual gifts to the Station should be noticed. Mr. William R. Lockwood of Norwalk, Conn., who died June 10, 1896, left half of his estate in trust to the Station and the other half conditionally. This also eventually came into the trust, the whole amounting to a little more than $200,000. The principal was to be held intact and the income to be used "in the promotion of agriculture by scientific investigation and experiment and by diffusing a knowledge of the practical results thereof among the people of the State of Connecticut" as the governing body of the Station deem most useful. In case of misuse of the trust, or if the Station ceases to exist, the trust terminates and the principal is given to the Sheffield Scientific School. This wholly unexpected gift has been a great boon and has made possible a development of the Station's usefulness which would have been impossible without it.

Prof. S. W. Johnson gave to the Station library, which now contains more than 14,000 volumes, 500 books from his own library, including very valuable series of agricultural and scientific journals, not otherwise obtainable. More recently his son-in-law, Dr. T. B. Osborne of the Station staff, has enriched the library by a much larger collection of rare and valuable works.

This very brief sketch necessarily omits any detailed account of the many pioneer undertakings, of the men who made them possible and of the present scope of the work. A complete history of the Station may be presented later.

THE PROGRAM

ANNIVERSARY EXERCISES

MONDAY AFTERNOON, TWO O'CLOCK

GREETING

William L. Slate, Jr., Director.

THE AGRICULTURAL EXPERIMENT STATION AND THE STATE

His Excellency, John H. Trumbull, Governor of Connecticut. President, Station Board of Control.

RELATIONS OF THE FEDERAL GOVERNMENT AND THE STATES IN AGRICULTURAL RESEARCH

Dr. E. W. Allen, Chief, Office of Experiment Stations, United States Department of Agriculture.

INFLUENCE OF EXPERIMENT STATIONS ON AMERICAN AGRICULTURE

Dr. R. W. Thatcher, Director, New York Agricultural Experiment Stations.

PRESENTATION OF PORTRAIT OF DR. JENKINS

Dr. Henry S. Graves, Provost of Yale University.

RESPONSE *Director Slate.*

ADDRESSES

The Relation of the Federal Government and the State Experiment Station

BY DR. E. W. ALLEN.

The Department of Agriculture extends cordial greetings and congratulations to this station on its fiftieth anniversary, an occasion of national interest because of the very significant forward step it commemorates. The station occupies a unique position as the original ancestor of a large and influential family, the progenitor of a new race in this country.

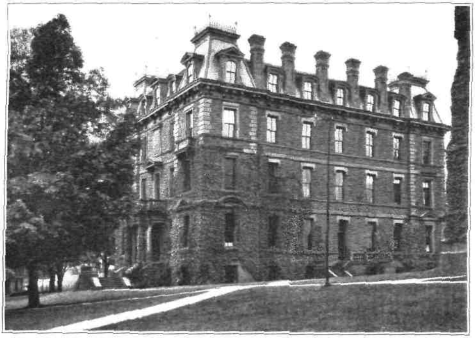
Age itself entitles to respect; age with noteworthy accomplishment brings honor and veneration. To be the forerunner of an idea which has proved so sound and practical as to be propagated in every State and Territory of the Union, and in the distant islands of the seas, is just cause for pride and self-congratulation. But modesty has always characterized this station, and it will be for its friends to bring the mete of praise it so well deserves.

In Washington we look with pride on the record of the Connecticut Station, and revere the names of its originators and leaders: Johnson, who as teacher, writer, and advocate, occupied a foremost position and wielded an influence exceeded by none; Atwater, who had the enthusiasm and persistence to impress others and to carry him over periods of opposition and discouragement; Jenkins, whose whole career has been devoted to this institution, and who for some forty years carried forward its high traditions and created here, as he modestly puts it, "an atmosphere and a somewhat comfortable place for research workers." All honor to them!

This station has served its State not only, but its country. It long since ceased to be merely a State institution; it belongs also to the Nation. As no man liveth to himself, so no such institution as this exists merely for its own community. Its benefits and relationships are limited only by the range and the application of its work; and in the sense that its work and influence have been of country-wide importance, it has come to belong to American agriculture. It is a worthy contribution of the State to the national welfare through the advancement of sound knowledge.

The Connecticut Station was one of the first to take a broad view of research which reached into the fundamentals of science as a means for understanding the common things in agriculture.

It set a standard for work which reveals not merely the bare facts but their real meaning and significance. It has dealt with simple things in a large way. What it has undertaken has been done in no superficial manner, but by digging deep to find out what lay back of the things seen, realizing that these are not themselves causes but manifestations. Its work has lived up to the declaration in an early writing of Dr. Johnson, that "it is not the novelty or the glory of discovery, but the genuineness of discovery that is of first importance." It was a bold stroke for a public institu-



ORANGE JUDD HALL, WESLEYAN UNIVERSITY, MIDDLETOWN.

This building housed the Station during the first two years, 1875-1877. The Station quarters were on the ground floor in the southwest corner and are shown at the right of the picture.

tion established with practical ends in view—a new demonstration of what is practical. It has helped to show the impracticality of half truths, and the permanent value of inquiry that is thoroughgoing.

There used to be a homely saw that what man doesn't know doesn't hurt him, or he does not worry about. Doubtless this was never to be taken too seriously, but to an extent it expressed an attitude at one time. The establishment of this experiment station was a direct answer to any such philosophy, even as applied to the backward art of farming. It was a response to a growing conviction that what man does not know he ought to make an effort to find out, and that in some things this is a just concern of the

State. Mankind has learned by hard experience that lack of knowledge or misbelief has been the greatest source of loss and worries and mistakes, but the founding of this station was the first public expression by any State of this conclusion as related to the industry on which all depend. It was a recognition of the power of research to free from error and guide to progress. It is worth while recalling these facts as showing what this anniversary really means.

Two great agencies have been set up in this country for the advancement of farming—the Department of Agriculture at Washington and the experiment stations in the States. They are separate in organization but have a common purpose, and they bear a relationship in many ways unique in the domain of research.

It is interesting to recall that the Department of Agriculture and the agricultural colleges were provided for by Congress in the same year, 1862. The establishment of the Department was a realization of President Washington's hope, and a response to public opinion sponsored by the U. S. Agricultural Society. The colleges were founded on confidence in science and the ability of its teachings to advance the art and make it more self-reliant. Both the Department and the colleges fostered research, although they made relatively slow progress in it.

Farming in this country had depended largely on looking backward, on following the experience and traditions of the past. In contrast to this, the experiment station was a proposal to look forward. To some extent the facts of science were being brought to bear on agricultural questions, but they were mostly derived from borrowed science developed under quite different conditions and frequently misapplied. Here was a plan to anticipate practical experience, to aid in its correct interpretation, and to get new scientific facts applying to our own conditions. Public support for it grew slowly until the State of Connecticut had the courage and the vision to take the first step.

At that time the Department of Agriculture had a total appropriation of but little over $300,000, the largest items of which, aside from salaries, were for seeds, the collection of statistics, and printing. There were allotments of $24,000 for the experimental garden and grounds, $4,500 for the museum and herbarium, and $1,300 for the maintenance of a laboratory. These represented the scientific activities of this National Department when the movement in Connecticut was at its height, and nowhere else were any public monies provided for agricultural investigation. Against such a background, the establishment of this station and the winning of support for this new idea stand out in their true significance.

Once the example was set and the initial step taken, other States followed one by one, and a movement was soon set on foot for Federal aid to provide stations in all the States. In this Dr.

Johnson was active. A bill introduced in Congress in 1883 was without result, and in the summer of 1885 the Commissioner of Agriculture called a convention of agricultural colleges and experiment stations in Washington to promote the movement. The convention endorsed a new measure which had been introduced, and appointed a committee to follow it up; and two years later, in 1887, the Hatch Act was passed, which laid the foundation for a national system with an annual appropriation of $15,000 to each State.

SHEFFIELD LABORATORY, YALE UNIVERSITY, NEW HAVEN.

Here the Station was quartered for five years, 1877-1882. The rooms used by the Station were on the ground floor of the wing and are shown at the right of the picture.

This nation-wide subsidizing of research in agriculture was evidence of the change which had come in the conception of the relationship of the Federal Government and the States. It was a recognition of a joint responsibility in developing the industry of agriculture on a high stage of efficiency, and it was a new expression of what the general Government may do under the Constitution for the promotion of public welfare. The appropriation of money for use of the States was a new departure; and the amount carried was considerably more than most of the dozen existing stations were then receiving. Indeed only one had a State appropriation equal to the new Federal grant; most of them had less than half.

The Hatch Act came twenty-five years after the Land-Grant Act providing for agricultural colleges, and it was only a beginning. Nineteen years later the Federal support was doubled under the Adams Act, and in nineteen years more, in February last, the then prevailing amount was trebled by the Purnell Act. When this latest Act comes into full maturity each State will receive $90,000 a year, or six times its original donation in 1887. It was a very significant thing, as the Secretary of Agriculture remarked, that "at a time when the Federal Government is working under an administrative policy which calls for strict economy in the appropriation and use of public funds, both the President and the Congress have given their support to a substantial increase in the Federal funds for the use of the agricultural experiment stations in all the States." It was a fitting climax for this anniversary year.

The official relationship between the Federal Department of Agriculture and the experiment stations dates from the establishment of the national system. Provision was then made for a central office in the Department to aid and promote the work of the stations in all possible ways. It is worthy of mention that the first director of that office was Dr. W. O. Atwater, under whom the station in this State was originally organized. His vision was a broad one and his belief in the possibilities of the new system was well-nigh boundless. His influence in advocating proper standards and ideals was very large in those formative years.

The relationship of the Department has been progressive with the growth of the enterprise. Naturally such sums of public funds as were involved were found to deserve a measure of oversight which would secure their adequate use in accordance with the plans and purposes originally designed; and there were methods and standards and policies to be established. One can not speak of this official relationship without referring to the spirit and purpose which have characterized it from all sides, for these have been fundamental in preserving the harmonious, sympathetic feeling which has prevailed. I remember the quite natural feeling of uncertainty and apprehension which the more definite provision for supervision in the early nineties caused in some quarters, but this was soon allayed by the fair-minded, considerate course pursued by Dr. True, who had these matters in charge for so many years.

The administration of the Federal funds has been actuated by no desire of the Department to assume any of the functions or responsibilities of the State in the management of the stations, or to determine the lines of work to be followed. There has been no suggestion of coercion or control, no purpose to dominate or subordinate, no stipulation of State appropriations. The stations are recognized by law as State institutions, and special effort has been directed toward maintaining their individuality, and

strengthening their organizations. This policy of helpfulness and co-operation has been the guiding motive through all the years; and as one fully realizing the opportunity for misunderstanding, may I say, to the credit of the experiment stations, that I can conceive of no finer relationship between the Federal Government and the States.

In such a nation-wide system, with the varied conditions found in the States, there are some things a central agency can do more effectively than the individual institutions. One of these is the

General Office and Library.

Director's residence and office at right, General Library at left. Property purchased in 1882. The brick building was erected in 1882, equipped as a chemical laboratory and used for that purpose until the completion of Johnson Laboratory in 1910. Then it was fitted with book shelves and has since been used as the General Library of the Station.

shaping of policies and guarding from harmful interference. The Federal laws and their interpretation have given a basis for sound policies and practices, and have set off the field of research from other types of activity. While such interpretations carry no authority beyond the funds from the general Government, the local authorities have applied them in large measure to the entire institution. This served in the early years to build up a sentiment and custom which have safeguarded the stations and their personnel. Local politics, which for a time menaced the management in some sections, have practically been eliminated. A power and authority which have rarely needed to be invoked have had a steadying influence, exercised through counsel rather than force.

The Federal relation also has been directed toward the development of standards for the work of the stations, viewing it from a broad viewpoint. This was especially the case during the formative period, when the local conception of their field and function was less clear and when the methods were in an initial stage. Much of the work was of elementary character, and sometimes tarried unduly in that stage. There were few leaders and many leaners, with the result that there was much imitation and duplication. Such duplication was frequently unwarranted because it was not co-ordinated or correlated, and hence did not advance the subject or lead progressively to the next stage as it should.

Duplication and repetition have been a frequent subject of criticism from various sources. As distinguished from replication, there has been some ground for it. In a measure, it has been difficult to excuse, because the means have long been at hand for guarding against it. A review of the progress of agricultural research throughout the world has long constituted one of the Department's contributions in aid of investigation, and latterly lists of the projects of all the stations, classified and subdivided by topics, have been prepared annually for circulation. Still work has sometimes continued after it was calculated to add substantially to what is known, beyond a further confirmation often amounting only to a local demonstration. This, happily, is passing, and the condition is one of the evidences of increased strength and progress.

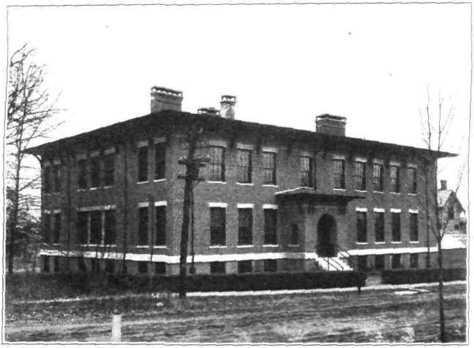
Furthermore, there has sometimes seemed to be a feeling that agricultural science is different from other science, and that research in agricultural subjects is different in quality and essentials from that in other lines. This view affected much of the earlier work of the stations—expressed in the attempt to get quick returns by short cuts. Because the aim was immediately practical there was sometimes a feeling that thoroughness and completeness were not essential, and that superficial efforts were quite as appropriate to the subject as more profound ones which could not be understood by the general public.

Empirical findings often served a temporary purpose at that stage, but it was soon found that the end of borrowed science and short-cut tests was reached, and many perplexing exceptions began to arise. The need was evident for broad truths and a better understanding of things observed. It was discovered that the farmers could not be given infallible rules and formulas, as had sometimes been expected, but that the reasons and limitations must be worked out to give an intelligent basis for individual judgment. The farmer must be a man of self-reliant judgment, able to use discriminatingly the tools which are prepared for him. He can be taught new facts but he never can be freed from the making of the applications to his own case and conditions.

There is an important difference between reducing experimental

results to practice—testing their applicability and working out their practicability, and the attempt to make rules and formulas for general application. One is interpretation, the other is predigested information without caution as to its use.

It is the glory of the experiment stations that their most scientific inquiries have a practical objective, and their work does not end until it has been shown how it fits into practice. But many of their investigations will, for the time being, seem to be of a



JOHNSON LABORATORY.

The present building occupied by the Departments of Analytical Chemistry, Biochemistry, Botany, Entomology and Forestry. The easterly wing was erected in 1905, and the larger portion of the building completed in 1910.

theoretical nature, and require tolerance and confidence on the part of the public.

Much that is designed to be strictly practical misses the mark. The very directness of its aim runs it to the ground. One of the things learned in these years of experience is that more often the shot with the high trajectory makes the decisive hit.

We need to increase the product of research. Changing conditions bring a constantly increasing group of problems which crowd for solution. A scientific fact remains unchanged, but it may be brought into new applications, and new facts will be needed to add to it and increase its potency. What we do not understand to-day we hope to understand to-morrow, through the agency of

new research, and this will make practice more enlightened and effective.

This is the basis of the Purnell Act, and of responsibility for the selection of live projects on the basis of permanent as well as temporary and local needs. The feeling that research is a creative function and not alone routine, and certainly not demonstration, finds general acceptance, and it is guiding the Department and the stations in the development of plans under the new Act. *It constitutes a further enlargement of relationships, with new standards and policies to be worked out.*

The Purnell Act is designed to give further aid to a group of institutions in existence from 35 to 50 years. It is to enable them *to build upon what has been done—to broaden and strengthen* the foundations where necessary, and progressively to carry tbe superstructure higher. Usually it will be some years before the roof can be put on, but the lower stories can be underpinned to make the structure secure, and one story after another added. The duplication of structures on an insecure foundation or according to plans shown to be inadequate is of course to be guarded against.

All research, whether actively co-operative or not, needs to be co-ordinated in the sense that it is planned and proceeds on the basis of what others have done and are doing—i. e., in accordance with the general status of the subject. If the work is constructive it will be guided by a constructive purpose; the defects or deficiencies or the limitations of what already exists will be the basis for the further effort. This may mean the necessity for laying the foundations deeper. It may mean rebuilding in part, or remodeling—sometimes only renovating; but in any event it will bear relation to what already stands, unless it be a new structure on a new site, in which case it will represent a new vision.

Despite all the uncertainties of research it is believed these things can be largely determined in advance and stated in the proposal. Clearness about them is evidence of preparation, and justification for the new undertaking. These are first steps in starting a new project; and so in passing upon such new proposals stress is being laid on a clear objective, a point of departure which takes account of the general status of knowledge in the subject, and procedure which is adequate at the start. The point of view and the method often will change as the investigation progresses, but at the outset it seems reasonable to expect that they should be forward-looking and constructive. Such a standard of quality is in the interest of all concerned. It will help to meet the high responsibility which the large sums of money received for research now entail.

In a further attempt to promote forward-looking and conclusive investigations under this new fund, more extensive co-operation in research has been strongly urged by Department and station

people, and is more definitely in mind than ever before. The Department has a great variety of work which needs to be brought into harmony and relation with similar work in the stations. The Secretary of Agriculture is anxious that this should be done. He has declared his belief that "co-operation is good for research people as well as for farmers. Waste and needless duplication are just as reprehensible in research as in the handling of farm products, and the Department of Agriculture and the experiment stations should set farmers an example in the elimination of wasteful methods."

Co-operation is not here used in the restricted sense of organized effort under a definite agreement and assignment of parts, but to refer to co-ordinated or correlated effort as contrasted with every man for himself. Research is an individual product, true enough, but in the experiment station it is a public enterprise, not a private one. Without repressing individuality and without dampening the incentive which comes from individual attainment—all highly important, a good deal is believed to be practicable in arranging co-operation on many-sided problems, in effecting an increased measure of co-ordination or correlation, and in bringing workers into closer association.

This view and objective have led to something of an extension of the Department's relations with the experiment stations. A number of subjects which lend themselves to co-operation have been selected by the stations, and these have been outlined by committees of specialists. Most if not all of them involve lines in which the Department is active, but this will not mean the assumption of direction or leadership. Many workers already have set up projects under these topics which will fit into the broader inquiry. Similarly, more local or regional subjects have been selected for co-operative or co-ordinated study. In the newer fields of agricultural economics, home economics, and sociology, in which there now is rapid expansion, the opportunity is especially inviting.

Not everyone will care to join in such enterprises; many workers already have lines of inquiry under which they will wish to continue; others may prefer to do their work independently. There will be no coercion—at least from the Department, anxious as it is that co-operation should have a fair trial and that much of its own work should be joined up with that in the States.

These things have no claim to novelty. They are only given a new setting and a new emphasis by the advanced stage which has been reached and the new epoch of expansion. They were more or less definitely in the minds of the early founders, and they were exemplified by them and by their successors. They are cited to illustrate the close relationship of the Federal Department and the experiment stations, and the common ends toward which they are striving.

Influence of Experiment Stations on American Agriculture

By Dr. R. W. Thatcher.

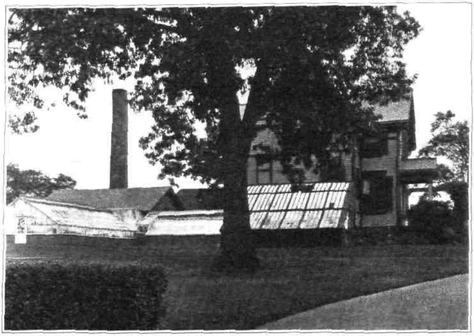
Fifty years ago the first of this month the Connecticut Agricultural Experiment Station was organized. Within the next ten years, a dozen or more states had followed this example. The success of these new ventures was so immediate and so generally recognized that there was no very great difficulty in securing the passage by Congress of the Hatch Act to provide Federal aid for the establishment of similar stations in each state in the Union. With the establishment of the station in Wyoming in 1891, only sixteen years after the organization of the Connecticut station, the chain of Federally-supported state agricultural experiment stations was complete. I cite this familiar history of an almost unparalleled development of a national policy for the promotion of agricultural welfare, in order to point out and to emphasize the wisdom of the founders of this Connecticut station and as the starting point for this discussion of the influence of the experiment stations upon American agriculture.

In most of the states, these stations were organized as a unit of the land-grant college and under the administrative supervision of the same officers who administered the teaching functions of the institution. In a few states, there were organized experiment stations which were entirely separated in their location, administration, functions, and activities from the teaching service. These separate stations apparently reflect a recognition at the time of their establishment of the need for agricultural research as a part of the State's agricultural development rather than as an adjunct to the teaching of agriculture in the college. Such an individual function of the station is now very generally recognized in all of the states. But in most cases, the agricultural research work is closely associated with the teaching duties of the faculty of the agricultural college, and in about one-half of the states the college itself is an integral part of the state university, with its graduate school which also has general research possibilities.

Under these circumstances, there has often been a failure to differentiate sharply between the experiment station research function and the university research function. Also, since the development of the extension service has taken over, in recent years, most of the opportunity and responsibility for direct contact of the research workers at the stations with the ultimate users of the constructive results of their efforts, there is often a failure by the general public to recognize the source of this new information and

to "give credit where credit is due." For this reason, it has seemed to me that it is wholly fitting and proper to use this anniversary occasion to point out just what is the contribution which the experiment stations have made, can make and will make in the future to agricultural welfare.

Reference has been made frequently to the fact that the earlier activities of the first experiment stations were largely in connection with the securing of data which led to the passage of various laws for the protection of farmers from fraud in the sale of



THAXTER LABORATORY, GREENHOUSE AND HEATING PLANT.

The wood building at the right houses on the first floor the Department of Soil Research and on the second floor the Department of Plant Breeding. The building was erected in 1888 for the Botanical Department and later the Entomological Department used the second floor, both Departments moving into Johnson Laboratory on its completion in 1910. The greenhouse was erected in 1895, and the central heating plant marked by the tall chimney was constructed in 1917; this contains a small assembly room.

fertilizers, feeding stuffs, etc., and later in aiding in the enforcement of these laws. Sometimes it has been said that these activities hardly justified the name "experiment station," and in later years it has become fairly customary to look upon these regulatory activities of the stations as of a somewhat lower order of service to agriculture than the research work of the station. But I am inclined to think that this earlier type of service reflects an attitude by and toward the station which we ought to cherish and strengthen in every way; namely, the recognition of the station as

an unbiased and unimpeachable fact-finding and truth-reporting agency for agricultural and public welfare.

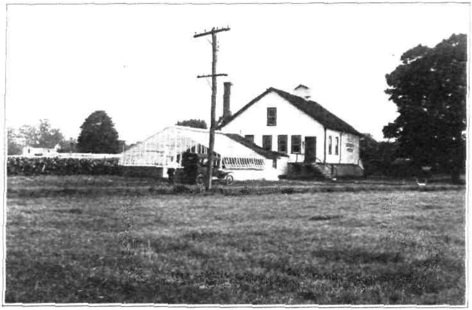
In the early days, there was also another aspect of station activities which has disappeared to a considerable degree with the increasing efficiency of organization of land-grant college work which yet had in it certain elements which we ought to cherish and preserve as best we can. I allude to the fact that, prior to the organization of the agricultural extension service, the scientists at the experiment station were called upon to give both resident and field instruction in agricultural practice, often to an extent much beyond that which could be justified as the making public or putting into effect of the results of their own investigations. The sharper differentiation between the teaching and the research function in recent years, and particularly, the organization of the extension service, has diminished the demand upon station workers for extraneous teaching services; but it has also shut off to a very considerable extent the direct contact of these station workers with the farmers of the state; and there is a real serious difficulty confronting the station administration to keep alive any appreciative recognition of the source of the knowledge which is being imparted through extension teaching. There is also a real loss to the research worker if the lack of opportunity to present the constructive results of his studies diminishes his sense of responsibility to secure such results and of that achievement which comes from the presentation of these results to appreciative audiences.

At the time of the preparation of this paper, I was not quite sure what would be the nature of the audience to which it would be presented. Hence, I was at a loss to know whether the most effective discussion of the topic would be a presentation of a series of striking contributions of experiment stations to agricultural science and practice which would be interesting and perhaps convincing to a farmer audience, but more or less stale repetition of familiar material to other scientists; or whether a more academic discussion of the place of station research in the public economy would be of more interest and use to this audience. It seemed to me, however, that there could be no question as to the propriety of emphasizing on this occasion the place and importance of the leadership which experiment stations have had and should have in the agriculture of the state and nation.

The retirement from active service during the past five years of such imposing figures in American agricultural history as Experiment Station Directors Woods of Maine, Brooks of Massachusetts, Jenkins of Connecticut, Jordan of New York, Armsby of Pennsylvania, Thorne of Ohio, and Davenport of Illinois has given excellent opportunity for the evaluation of personal and individual leadership in these fields. More than this, it has called attention to the guiding principles upon which their unquestioned leadership was based. It would be impossible, in the brief space of this

paper, to adequately review the publicly expressed opinions of all of these men concerning the service which they have sought to have their institutions render to the cause of agricultural development. But a few quotations selected at random from the many gems of concise and illuminating statements which came from their pens will serve to illustrate the viewpoints which these sages of American agricultural research brought to their work.

Dr. Armsby is quoted as having said, after first pointing out the purpose of the station to select for study problems which appear to



TOBACCO EXPERIMENT FARM, WINDSOR.

Thirteen acres purchased in 1921. View showing laboratory and greenhouse erected in 1924.

be of most immediate practical importance: "It will seek to do thorough, conscientious work; to do a few things well, rather than many superficially." Concerning the function of the Experiment Station, he maintained that this is not the impossible task of giving the farmer recipes suited to every conceivable emergency—not a device to save the farmer the trouble of thinking—but rather to enlarge the farmer's knowledge, to make him think more; and he maintained that it is only to the extent that the farmer can by his own thinking digest and utilize the Station's help that the latter may expect to assist him permanently and effectively; he said "The true field of the experiment station is the farmer's mind, not his acres."

Dr. Thorne's view may be fairly well summarized in the following quotation: "The agricultural experiment station is a necessary

and indispensable complement to the college of agriculture, for the experiment station is both the crucible in which theories are tested and the fine gold of truth is separated from the dross of error, and the instrument of research by which further progress is made into the realm of the unknown. After all is said, it is to the soil and its secrets that we must turn for the material progress of the race; and when material progress ends the intellect will also stagnate."

Dr. Jordan's views are well known to most of you. They may be summarized in the following sentences quoted from different addresses made by him on several occasions: "The greatest and most permanent acquisitions that have come to agriculture as an art during the past fifty years are the outcome of profound scientific study." "We should guard against centering an experiment around facts or conditions which are of merely local or temporary importance." To this he added that agricultural literature "is already cluttered with so-called practical conclusions that in a brief time will be swept into the rubbish corner." He held that experiments should "deal with matters of general and permanent utility," and that the contributions which have really enriched agricultural practice "are mostly those which have been proclaimed from the inner temple of science," and that "the discoveries of scientific truth which are to-day blessing the farmer in his daily toil are mostly those which have been reached through the severest and most searching investigations."

Expressed in other terms than those which I have just quoted, I think that it may be said that it is the duty and the opportunity of a state experiment station to contribute to the agriculture of the State and nation such information concerning the problems of agriculture as can be ascertained by *the scientific method* of investigation rather than the results of practical experience in farm operation. Presumably, it is not necessary to explain to this audience what I mean by the *scientific method;* but a word as to its application to the problems of agriculture may not be amiss.

Briefly, it may be said that modern science seeks to understand the laws of nature rather than simply to learn her facts. The scientific method consists in bringing together as many related facts or phenomena as possible in order to develop therefrom a theory as to the probable cause for the observed facts, then to test this theory by every possible critical analysis to the end that the theory may finally be recognized and adopted as an hypothesis or law on which later plans may be safely based. In substance, the scientific method is to study facts with the view to the discovery of fundamental laws, in order that working practices may be based on these laws, rather than upon empirical recipes or so-called "rules-of-thumb."

Of course, a knowledge of the facts themselves is a necessary part in the development of agricultural practice, and the calls for

information which come to the experiment station are usually requests for such facts or for rules of practice which can be followed without any particular thought concerning the fundamental principle involved. While this kind of information may satisfy the immediate needs of the individual farmer or fruit-grower, progress in the development of a sound agricultural practice and an intelligent farming population is much more to be expected from a more fundamental and better established knowledge of the laws of nature with reference to crop growth, animal production, etc.

STATION FARM, MOUNT CARMEL.

View during Field Day, August 1924. This farm contains thirty-five acres, of which twenty acres were purchased in 1911, and fifteen acres in 1915. On this farm are conducted many experiments in plant breeding, spraying and fertilizing of orchard, field and garden crops.

In the earlier stages of agricultural experiment station work, before these principles were so well appreciated, the investigations were largely elementary in character and based largely on observations, comparative trials, and simple field experiments which did not seriously attempt to establish the underlying principles. The results of these early experiments have been very useful and have supplied a fund of information on which much of the successful agricultural practice at the present time is based. There will almost certainly continue to be need for carefully controlled experiments of this kind in order to furnish accurate information to farmers concerning matters of farm practice about which their own individual experiences lead them to be in doubt. But there ought to be a continually increasing fund of fundamental knowl-

edge of agricultural science going abroad in the land, so that there will be steadily less and less of these questions which the intelligent farmer is unable to understand and answer for himself.

Having dwelt thus at some length on the necessity for research which shall be fundamental in character so that it will lead to intelligent knowledge rather than "rule-of-thumb" recipes as the basis for farm practice, I turn now to a consideration of the means to be used, or the general method of attack upon problems of this kind. Here, I find myself apparently somewhat at variance with the attitude which seems to have been taken by some of my illustrious predecessors in administration of agricultural research. For a long time, there has been among university scientists a school of workers who have held that real advance in human knowledge can be made only by the study of purely natural phenomena. These scientists have scrupulously avoided the study of plants and animals which have economic uses and have confined their researches to those phenomena which have had no artificial influences in their development. Such men will have nothing to do with a study of cultivated varieties of fruits, for example, saying that the natural basis for their classification has been disturbed by the domestication process. To men of this type, the so-called "practical application" of science is a commercial, non-intellectual process which is beneath the dignity of a true scientist. Such conceptions used to be common and discussions of the relative merits of so-called "pure science" and "applied science" were numerous and acrimonious. I have thought that I have observed an influence of the earlier academic viewpoint upon some of the announced plans for the development of agricultural research. Fortunately, however, Dr. Armsby's statement that experiment station problems must be those which are of most immediate practical importance has generally been the guiding principle in the selection of the problem to be worked with and generally also in the selection of the material with which the investigations are to be made.

There are still many college faculties which insist on the preservation of the A.B. degree as an insignia of true education and culture and hold that the B.S. degree should indicate the completion of a course of vocational study which is in itself less intellectual or less cultural than the non-vocational arts course. These ideas, which were more prevalent and more pronounced twenty-five years ago than they are now, have undoubtedly had some influence upon the minds of some of the men whose opinions with reference to the character of the best research work in agricultural science I have quoted above. Personally, I came up through the science course of a university with a fixed conviction that all of the necessary elements of a real education can be obtained through the study of the materials and facts of every-day life and surroundings as well as, or better than, through the study of dead

languages, ancient art, or foreign physical surroundings. I have felt that the same powers of memory and of reasoning can be developed through the study of current literature, laws and customs as well as of those of by-gone ages. I have believed that just as keen an appreciation of beauty of form, of expression and of life can be developed through a sympathetic study of Nature as she manifests herself in the forest, lakes, mountains and fields about us and of the wonderful creations of men in our cities, transportation lines, etc., as by the study of the paintings of old Masters,

EXPERIMENTAL FOREST, LOCKWOOD FIELD, WINDSOR.

This field was purchased in 1900, with additions in 1905 and 1908 totaling about 100 acres. *In background at left, red pine and at right Scotch pine,* seventeen years after setting. In foreground, white pine, six years after setting.

the ancient cathedrals or the splendors of profligate civilization of by-gone days. I have steadily held the conception that the powers of accurate observation, logical reasoning, and sound deduction can be just as well developed by the study of the phenomena of nature with which we are surrounded and in every-day contact as by any degree of profound consideration of those things which are without any taint of economic use or practical application. In short, I have grown up with the conviction that a *real* education may be obtained using the facts, phenomena, and materials of every-day life as the materials with which to illustrate or from which to derive the principles which are to be learned.

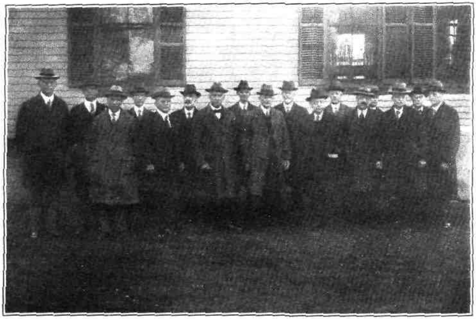
With these ideas in my mind, I naturally feel that the materials with which we are to work at the experiment station should be those which are of common occurrence and of practical use on the farms and in the orchards, etc., of our own State. The study, by the scientific method, of any problem in agricultural science or practice will, I believe, be as certain of giving accurate data for the solution of the problem in question and at the same time will yield a fund of practical working information such as cannot be secured if the materials worked with are foreign to our every-day working conditions. For example, it seems to me that the study of a problem in plant breeding may better be carried on with wheat, raspberries, or some other economic crop and be so planned that the results of the investigation may yield an improved new strain of field or garden crops, than with larkspurs, sweet peas, or skunk cabbage. Similarly, other things being equal, I should prefer to use swine instead of guinea pigs for studies of animal nutrition, chickens instead of pigeons, for studies of deficiency diseases, etc. To be sure, it is sometimes simpler and easier, and often cheaper, to use non-economic plants or animals for studies of general fundamental principles of heredity, nutrition, disease-resistance, etc. But as a general principle, it seems to me to be wise to have a definite economic improvement of the species, or some profitable end in view, at the same time that the data necessary from the establishment of the fundamental principle in question is being sought.

In other words, I would have the Station worker seek to secure fundamental scientific principles, but at the same time "keep his feet on the ground" in choosing his material and planning his analytical studies.

Perhaps I can best illustrate the service which the station renders to agriculture by using the simile of the doctor as an agency for promoting human health. Each community needs to have its local doctor who can be called upon at any time to give advice and render assistance for immediate needs, bringing to the community the best that is known concerning sanitation, campaigns against communicable diseases, and the curing of the ills of his constituents. But the local practitioner is not a research investigator, the latter is always located at some hospital or city laboratory where the necessary clinical material and specialized equipment for the study of new diseases or new methods of combating known ones are available. The medical research worker conducts his experiments with all the scientific skill which he possesses, until the new operation the new method of treatment or the new plan of protection of public health is well established; then he publishes his findings and intelligent citizens everywhere follow his advice so far as they are able to understand it and apply it. But when their individual problem gets beyond the scope of their own learning or ability, they call upon the local doctor, who brings to their service

the results of the researches at as many laboratories as possible, as well as those of his own experience in dealing with these matters of health.

Now, if we apply this simile to agricultural needs, it is plain that the local doctor represents the local agricultural extension worker, the county agent, or his assistant. He ought to be near at hand and always available with skillful advice and assistance as needed. He should conduct demonstrations, give public instruction, and personal assistance in all matters which are sufficiently established to be past the experimental stage. He may even conduct simple experiments of his own, provided he does not under-



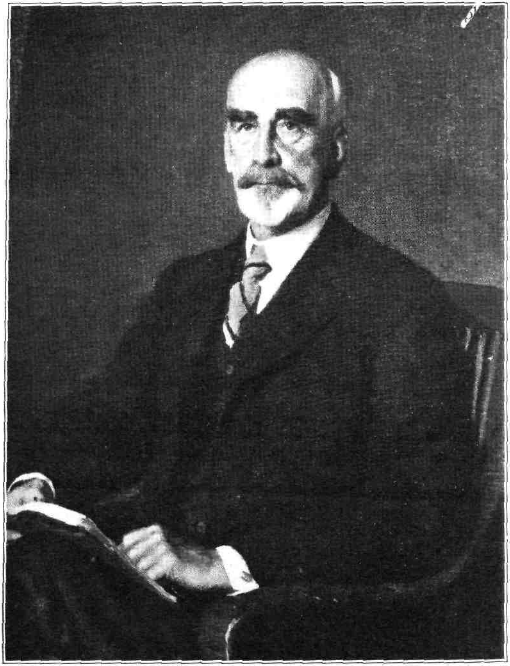
A GROUP OF STATION DIRECTORS AT THE SEMICENTENNIAL.

take experiments which may result disastrously to his constituents, or interfere with his readiness to render the service for which his constituents call rightfully upon him. The research worker is located at the experiment station where the clinical material and right equipment for his study are available. The research worker, if he is to render real service, must not let his investigations lead him off into realms which have no connection with the agricultural needs of his constituency, but he must be free to prosecute his investigations without interruptions by calls to attend individual needs for assistance. These latter ought to be provided for by the local practitioners. But the research worker ought to be in close enough touch with the people and conditions which his study is to benefit so that he will not be led away from a constant attempt to meet a definite need for fundamental, sound, and scientific

information which will be applicable to the conditions which he is seeking to alleviate or improve.

I am in doubt that this admittedly academic discussion of the relation of experiment station work to agricultural development has been altogether appropriate to this occasion. I was emboldened to undertake it because it seemed to me to be so clearly the lesson of experience of half a century of experiment station work, and that the historic figures of the Connecticut station were such shining examples of the successful application. I know that I have not done justice to the clear-minded convictions and brilliant achievements of Johnson and Atwater, of Jenkins and Osborne and Mendel; but I have tried to raise aloft the lamp which it seems to me has guided their feet and illumined their pathway to noteworthy achievements and world-wide honor and respect. I hope that I have been able to say some things which modesty might have prevented their saying.

In closing, I wish to voice the debt of gratitude which we of the next younger generation of station workers owe to the pioneers in this field, not the least of whom are the members of the staff of this Connecticut station whose fiftieth anniversary we are to-day celebrating. The earliest of our stations naturally had no other experience to guide them. We have had their example. Fortunate has it been for us that the standards which they set were so high and the ideals which they cherished so noble. Our contributions to the exercises of to-day are but a feeble attempt on our part to recognize this debt. We salute you, we congratulate you, we wish for you years of added success and achievement.



Edward Hopkins Jenkins

PRESENTATION

OF

PORTRAIT OF DR. JENKINS

By Dr. Henry S. Graves

It is my happy privilege to speak on behalf of the friends of Dr. Jenkins in presenting a portrait of him to the Agricultural Experiment Station. This I am particularly glad to do, not only because of my admiration for him and for his many public services, but also because of our personal friendship of many years' standing and an affectionate regard for him that is shared by a great host of friends in this community and throughout the States.

It is in no sense of fulsome praise that I say that Dr. Jenkins has made the greatest individual contribution to the economic development of Connecticut. The very structure of Connecticut Agriculture has been built upon the sound foundations laid through his efforts and those of his associates.

His leadership has rested upon his ability as a scientist and executive; but he has also been a great educator of the people of the State. Tens of thousands of farmers and men connected in various ways with the agricultural industry have been his pupils and are applying in practice what they have learned from him and those working with him.

Few men have had the opportunity to carry on a public work for so long a period and to see their efforts crowned with such success. Few men have been able in so great a measure to command the confidence of the community. A man of simple and straightforward character, of rare judgment in public matters, and seeking only what is in the interest of the community and state, he has enlisted the support of the people in his work to an extent possible only by a great public servant. Is it any wonder that the legislature could not refuse his requests for the support of his work or that the people could not fail to listen to his instruction?

His tact and fine judgment enabled him to bring together in effective effort the two branches of the experimental organization in Agriculture and to harmonize the research and educational undertakings of the State.

Associated with the early research enterprises in Agriculture with Professor S. W. Johnson, nearly fifty years ago, he soon became a leader whose influence was felt in the national work of building up our agricultural experiment stations.

We love him for his service to the public, but even more for his personal qualities. Possessed of rare wit and felicity of expres-

sion, he has always been under pressure to speak at public gatherings. Inspiring as a speaker and writer, with a broad vision in public affairs and with a natural sympathy with the viewpoint of the average man, he has unfailingly been able to command the attention of those who have had the good fortune to hear him speak or to read his written messages. It is quite characteristic that after a half century of arduous work devoted to public service he should continue his writing, as is illustrated by his admirable work on Connecticut Agriculture in Mr. Norris G. Osborn's History of Connecticut. His influence continues, stimulating those who have taken up his official work and those who are seeking to measure up to his high standards of achievement in the service of the State.

It is with a deep sense of appreciation of what he has accomplished and with warm personal affection for him that his friends present this portrait to the Agricultural Experiment Station.

Memorials

TO ALL ASSOCIATED WITH THE CONNECTICUT AGRICULTURAL EXPERIMENT STATION.

The Director and Staff of the Rothamsted Experimental Station, desire to take the opportunity presented by the occasion of the Fiftieth Anniversary of the foundation of the Connecticut Agricultural Experiment Station, to express to all connected therewith the high esteem in which it is held among those interested in agricultural science in this country.
We recall with interest that it was the first Agricultural Experiment Station to be set up in the United States in those early days when Rothamsted was but thirty two years old.
We still read with pleasure the writings of its first Director, S. W. Johnson.
Among the chemists who have worked there stand out the names of, H.P. Armsby, Milton Whitney, and T.B. Osborne.

who in their several fields have contributed largely to the advance of science and have brought much fame not only to the Institution and themselves, but to their country. It will always be remembered that Osborne's work on proteins was carried out at the Connecticut Experiment Station. The work of the second Director, Dr. Jenkins, in developing agricultural research is too well-known to need comment. It would be invidious to particularise further, but we fervently hope that your Station may in the future maintain and if possible enhance its high reputation in the scientific and agricultural world.

Signed on behalf of the Rothamsted Experimental Station.

E J Russell

7th October, 1925 Director.

The Governing Board of the Sheffield Scientific School of Yale University

extends its congratulations to the

Connecticut Agricultural Experiment Station

on the occasion of the celebration of the

Fiftieth Anniversary

of the founding of the Station, on Monday, October the twelfth, one thousand nine hundred and twenty-five.

It is a matter of no little satisfaction to the Governing Board to recall that it has played, throngh the work and influence of a number of its members, an important part in the development of agricultural science in the United States and particularly the work of the Connecticut Agricultural Experiment Station. Samuel William Johnson, for fifty-four years a member of the faculty of the Sheffield Scientific School, was a pioneer in agricultural science and was largely responsible for the establishment of the State Board of Agriculture and the first Agricultural Experiment Station, which to-day celebrates its semi-centennial. John Pitkin Norton, John Addison Porter, and William Henry Brewer are among those who took a keen interest in the work of the Agricultural Experiment Station and rendered it valuable service. There are also among the members of the Governing Board at the present time several who are in one way or another contributing to the development of agricultural science. It is the wish and hope of this Board that the close affiliation that has always existed between the Connecticut Agricultural Experiment Station and the Sheffield Scientific School may continue in future years.

President

Secretary

Printed at the Yale University Press, in New Haven, Connecticut, in the year of Our Lord the one thousand nine hundred and twenty-fifth and in the year of Yale University the two hundred and twenty-fifth.

THE TRUSTEES AND FACULTY

of the

Connecticut Agricultural College

Extend their Congratulations to the

Connecticut Agricultural Experiment Station

on the occasion of the Celebration of the

FIFTIETH ANNIVERSARY

of the Founding of the Station

on Monday, October the twelfth, one thousand nine hundred and twenty-five

THE anniversary celebration of an institution that has completed fifty years of successful work is a just reason for pride and satisfaction to its board of control and to the members of its staff, but we feel that there is a special honor due to the Connecticut Agricultural Experiment Station in having inaugurated a movement for organized agricultural research that has been followed by every state in the nation.

It is our hope that the institution, so well founded as to become an example, and so wisely directed as to attain such notable distinction, may continue its contribution for the future years.

Signed,

Charles L. Beach,

For the Trustees and Faculty
Connecticut Agricultural College.

BULLETIN 281 AUGUST, 1926

Connecticut Agricultural Experiment Station

New Haven, Connecticut

GENERAL INDEX

TO

REPORTS OF THE

STATE ENTOMOLOGIST

OF

CONNECTICUT

1901-1925

W. E. BRITTON, Ph.D.

State Entomologist

The Bulletins of this Station are mailed free to citizens of Connecticut who apply for them, and to other applicants as far as the editions permit.

CONNECTICUT AGRICULTURAL EXPERIMENT STATION

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as of

August 1926

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REPORTS OF THE STATE ENTOMOLOGIST

The report of the State Entomologist has been issued each year, beginning with the establishment of the office in 1901. Consequently the number of each report is the same as that of the year which it covers, in this the twentieth century. Thus the 1st Report covers the year 1901, and the 25th Report the year 1925. For the sake of brevity the first two figures have been omitted, thus '01, '25. As the Annual Reports of the Station contain the Reports of the State Entomologist, in this index it seemed best to cite the number of the year instead of the report number, so that the index may be used as well for entomological matter in the full Station Reports as for the Reports of the State Entomologist.

As there are now many entomologists who keep files of these Reports, and as certain scientific and public libraries bind them separately, though each has its own index, a general index is a great help to ready reference and will make the set far more useful. Nearly half of these Reports, particularly the earlier numbers, are out of print and cannot be furnished except as occasionally copies are returned. These are reserved to complete sets for institutions and entomologists.

Acknowledgment should here be made to other members of the Entomological Department, for assistance in planning this index and in preparing the manuscript.

ERRATA

1903

Page 217, seventh line from bottom, for "*Chinaspis*" read *Chionaspis*.
Plate viii, b and c, show work and pupa of *Sesia tipuliformis*, Linn., instead of *Psenocerus supernotatus* Say.

1904

Page 201, fourteenth line from top, for "20000" read 2000.

1905

Page 256, third line from bottom, and index, for "*hamadryella*" read *hamadryadella*.

1906

Page 223, second line, for "has" read have, and for "are" read is.
" 240, second line, for "if needed" read where necessary.
" 243, sixth line, for "was" read were.
" 253, twentieth line, for "137" read 138.
" 301, twelfth line from bottom, for "850" read 350; fifth line from bottom, for "were" read was.
" 306, tenth line, for "larva" read larvae.

1907

Page 271, second line, for "weight" read weigh.

1908

Page 777, last line, for "Ridley" read Riley.

1909

Page 674, *sixteenth line from top, for "xxiii"* read xxviii.
" 678, seventh line from bottom, for "xxiii" read xxviii.
" 696, subtitle, and 697, seventh line, legend under Fig. 18, page 698, eleventh line, and legend under Plate xxix, c, for "*Hemiscopis*" read *Hemiscopsis*.

1920

Pages 142 and 143, top of third column, for "average" read acreage.

1925

Page 228, seventeenth line from bottom, for "*abbietis*" read *abietis*.
" 278, eleventh line from bottom, for "*Toxoptera graminum*, Rondani," read *Rhopalosiphum prunifoliae*, Fitch (*Aphis avenae*, in part, of American authors).
" 321, tenth line, and in legend under Plate xvii, b, for "*salicifolia*" read *Thunbergi*.

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Connecticut Agricultural Experiment Station

New Haven, Connecticut

TOBACCO STATION OFFICES, SORTING SHOP, AND GREENHOUSE.

REPORT OF TOBACCO STATION AT WINDSOR

1925

The Bulletins of this Station are mailed free to citizens of Connecticut who apply for them, and to other applicants as far as the editions permit.

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as of

February, 1926

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THE TUTTLE, MOREHOUSE & TAYLOR COMPANY

Report of Tobacco Station—1925

P. J. Anderson, et al.

INTRODUCTION

When the writer assumed charge of the work of the Tobacco Station, April 1, 1925, there were certain old lines of investigation which had been in progress for one, two or three years. Most of these were planned as long time experiments and in the main have been continued with but slight modification. Several new lines of work have been started and the old projects expanded. There are so many unsolved problems in the growing, curing, and fermenting of tobacco that it is obviously impossible with the present resources at our disposal to work on all of them. It is better to concentrate on a few than to do a little on all. Therefore a few of the problems, the solution of which seemed to offer most hope of permanent benefit to the grower and for which there was the most insistent demand were selected. It is realized however, that there are many other important ones and these will be undertaken as fast as time and resources will permit.

In the following pages, progress of the work up to date, on each line of investigation, is described in some detail. Few of these projects are complete and the present should be considered only a report of progress. It has seemed best to make these reports annually rather than to wait until the conclusion of each project because a part of the findings are immediately applicable and because a full discussion of the work while in progress invites suggestion and criticism which is helpful in further planning.

A list of the lines of investigation which are now being carried out at the Station is included here. This is followed by a detailed discussion of each one which has progressed far enough to warrant a report.

LIST OF TOBACCO STATION PROJECTS.

1. *Fertilizer Experiments.* A continuation of the old project but with some modifications and additions. Fully explained in the following pages except for the experiments on the effect of magnesium, chlorine and sulfur which are in coöperation with the United States Department of Agriculture.
2. *Strain tests of Havana seed and Broadleaf tobaccos.* Second year of these tests. Fully discussed in the following pages.
3. *Improvement of Shade Tobacco by breeding and selection.* In coöperation with Dr. D. F. Jones of the Plant Breeding Department. Partly an old project, partly new in 1925.
4. *The value of cover crops for tobacco.* New project begun in 1925. Since the cover crops were not planted until the fall of 1925, there are no results to report.

5. *Brown Rootrot.* In coöperation with Dr. G. P. Clinton of the Botany Dept. and Mr. H. F. Murwin of the U. S. Dept. of Agriculture. Results not reported here, but a general statement of the problem on page 66.
6. *Relation of soil reaction to black rootrot and optimum growth of tobacco.* In coöperation with Prof. M. F. Morgan of the Soils Department. Fully discussed in this report. Started in 1925.
7. *Investigation of cigarette types of tobacco for the Connecticut Valley.*
8. *Use of artificial light in the growing of Shade tobacco.* In its second year. Completed in 1925.
9. *Tests of chemically treated shade cloth.* Project in its third year.
10. *The role of humidity and temperature in curing.* This project was started in 1925 late in the season because of delays in installing the Carrier curing chambers. Not discussed in this report.
11. *The role of nitrogen and sulfur in the metabolism of the tobacco plant.*
12. *Topping and suckering experiments.* Effect on yield and quality.
13. *Relation of acid and alkaline fertilizers to Black Rootrot.* Project of the Botany Dept. under Dr. Clinton with field plots at the Tobacco Station. Not reported here.
14. *Control of wireworms.* In coöperation with the Dept. of Entomology and with the American Cyanamid Co. Emergency project begun in June, 1925. Preliminary report on page 74.
15. *Miscellaneous tobacco disease investigations.* This is a general project flexible enough to permit investigation of outbreaks of diseases which cannot always be predicted.

In addition to the above there are two lines of investigation of tobacco diseases undertaken by the botany department independent of the tobacco station, but of vital interest to the tobacco grower. These are the cause of the *mosaic disease* by Dr. Clinton and the life history of the *black rootrot fungus* by Dr. McCormick.

The function of the Tobacco Station is twofold. In the preceding paragraphs we have been considering only the first and primary function, viz., the research work, which attempts to find out something new and helpful to the grower, improve the quality or yield, or cut the cost of production. The second function is to carry the results of this investigation, augmented by all the information we can secure from other sources, directly to the grower. The first method of putting the information at the disposal of the farmer is through publication of results. Since the establishment of the Station, five bulletins have been published and the reports have been necessarily brief. This report is as complete as possible at the present time and covers all projects. Later bulletins dealing more fully with specific lines of investigation are also planned.

The fourth annual field day, attended by over four hundred growers, was helpful in bringing the growers and the Station into closer contact. Results of the investigations have been presented to gatherings of growers in a number of other public meetings. Many growers have visited the Station for personal consultations and many more have asked that members of the Station staff make visits to their farms. No request of this kind

has been refused during the year. Such personal visits and consultations are, we believe, generally more helpful than public meetings, not only to the grower but to the station members who thus gain valuable first-hand knowledge of field conditions which is important if our work is to keep in vital touch with the grower. In this field work we have had the close coöperation of the Hartford County Farm Bureau and the Field Service Department of the Connecticut Valley Tobacco Association.

Considerable time has also been spent in more direct personal

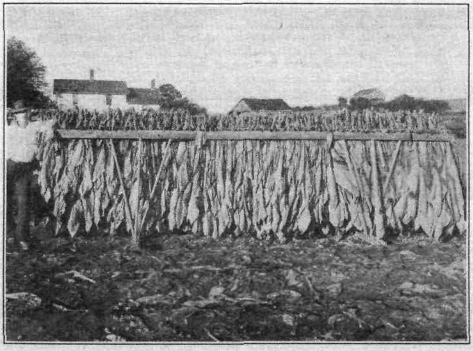

FIG. 1.—Long tobacco on the "hurdles." Fertilizer plots on station farm. 1925. This tobacco never touches the ground after spearing.

service such as testing and separation of seed, testing soil samples, diagnosis of diseases, and the like.

The work has been made possible not only by the appropriations of the State Legislature, but also by the generous support of the Connecticut Valley Tobacco Improvement Association and the Connecticut Valley Tobacco Association. Both of these organizations, because of their loyal support, deserve great credit. Growers and dealers, too numerous to mention by name here, have aided by their coöperation, support and kindly advice. The following farmers coöperated during 1925 by growing tobacco on their farm for the strain tests described later: J. B. Stewart of Windsor, Stanton Brown of Poquonock, Howard Ensign of Silver Lane, Ed. Handel of Glastonbury, Horace Vibert of South Windsor, Albert Oakes of Windsor, L. A. Bates of East Granby, and W. W. Sanderson of South Deerfield.

FERTILIZER EXPERIMENTS

P. J. Anderson and N. T. Nelson

The Old Nitrogen Series

This is a continuation of the series which has been in progress since 1922. For a detailed description and the results of the first three years the reader is referred to Bulletin 5 of the tobacco station. The objects of this series were to compare the yield and quality of Havana seed tobacco when:

1. One-fifth of the nitrogen is supplied in mineral carriers.
2. One-half the nitrogen in mineral carriers.
3. None of the nitrogen in mineral carriers.
4. One-half the nitrogen in dry ground fish.
5. One-half the nitrogen in high grade tankage.

The other carriers of nitrogen are cotton seed meal and castor pomace, which are considered standard.

Although the experiments were on the same plots as during the preceding three years, a few modifications were made for 1925 as follows:

1. The plots on which all the nitrogen was supplied in mineral carriers have been discontinued because the results of the preceding years showed that the tobacco grown with this fertilizer ration is so coarse and inferior in quality as to discourage further trials.

2. Nitrate of potash has been omitted in 1925 because the supply on the market seems to be limited and uncertain and it is questionable whether results obtained would be of practical benefit to tobacco growers.

3. Instead of combining nitrate of soda and sulfate of ammonia in one mixture as sources of mineral nitrogen, the two have been used independently on different plots. In this way the effects of each may be observed independently.

4. Acid phosphate has been omitted from the formula and the extra phosphoric acid supplied from precipitated bone which is considered a better source in tobacco fertilizers because it contains little if any sulfate. This also has the advantage of simplifying the formula.

5. In the preceding years, the acre applications of the three fertilizer plant nutrients have been: ammonia, 260 lbs.; phosphoric acid, 225 lbs.; and potash, 240 lbs. In 1925 this was reduced to 200-160-200 respectively. This was done first because the amounts previously applied were considered excessive on this land and it was feared that the effects of one nitrogen carrier would be masked by the excessive amount of another and secondly, because the adopted rates correspond in amount of plant

nutrients to the standard 5-4-5 grade used at the rate of two tons per acre.

6. The potash was supplied equally from carbonate and high grade sulfate instead of all from the latter as previously. In this way the amount of sulfate in the mixtures was again reduced.

The composition of the fertilizer ration for each plot is shown in the following tables.

NITROGEN SERIES—FERTILIZER APPLICATIONS, 1925.

Plot N1. 1/5 ammonia in nitrate of soda.

Carrier Name	Lbs. per acre	Cost an acre	Lbs. plant nutrient per acre NH_3	P_2O_5	K_2O	MgO
Cottonseed meal	1,463.4	$36.59	120	42.4	21.9	10.2
Castor pomace	588.2	8.82	40	10.6	5.9	4.7
Nitrate of soda	212.7	7.23	40	....	....	...
Precipitated bone	277.9	8.34	...	107.0	....	...
Sulfate of potash	172.2	4.74	...	....	86.1	...
Carbonate of potash ...	132.5	9.94	...	....	86.1	...
Total	2,846.9	$75.66	200	160.0	200.0	14.9

Plot N2. 1/2 ammonia in nitrate of soda.

Carrier Name	Lbs. per acre	Cost an acre	Lbs. plant nutrient per acre NH_3	P_2O_5	K_2O	MgO
Cottonseed meal	914.6	$22.87	75	26.5	13.7	6.4
Castor pomace	367.7	5.52	25	6.6	3.7	2.9
Nitrate of soda	531.4	18.06	100	....	....	...
Precipitated bone	329.6	9.89	...	126.9	....	...
Sulfate of potash	172.0	4.73	...	....	86.0	...
Carbonate of potash ..	132.3	9.92	...	....	86.0	...
Double sulfate	40.7	.71	...	....	10.6	4.6
Total	2,488.3	$71.70	200	160.0	200.0	14.9

Plot N3. 1/5 ammonia in sulfate of ammonia.

Carrier Name	Lbs. per acre	Cost an acre	Lbs. plant nutrient per acre NH_3	P_2O_5	K_2O	MgO
Cottonseed meal	1,463.4	$36.59	120	42.4	21.9	10.2
Castor pomace	588.2	8.82	40	10.6	5.9	4.7
Sulfate of ammonia ...	160.0	6.00	40	....	....	...
Precipitated bone	277.9	8.34	...	107.0	....	...
Sulfate of potash	172.2	4.74	...	....	86.1	...
Carbonate of potash ...	132.5	9.94	...	....	86.1	...
Total	2,794.2	$74.43	200	160.0	200.0	14.9

Plot N4. 1/2 ammonia in sulfate of ammonia.

Carrier Name	Lbs. per acre	Cost an acre	Lbs. plant nutrient per acre NH_3	P_2O_5	K_2O	MgO
Cottonseed meal	914.6	$22.87	75	26.5	13.7	6.4
Castor pomace	367.7	5.52	25	6.6	3.7	2.9
Sulfate of ammonia ...	400.0	15.00	100	....	....	...
Precipitated bone	329.6	9.89	...	126.9	....	...
Sulfate of potash	172.0	4.73	...	....	86.0	...
Carbonate of potash ..	132.3	9.92	...	....	86.0	...
Double sulfate	40.7	.71	...	....	10.6	4.6
Total	2,356.9	$68.64	200	160.0	200.0	14.9

Plot N5. All ammonia in cottonseed meal and castor pomace.

Carrier Name	Lbs. per acre	Cost an acre	Lbs. plant nutrient per acre NH_3	P_2O_5	K_2O	MgO
Cottonseed meal	1,829.3	$45.73	150	53.0	27.4	13.0
Castor pomace	735.3	11.03	50	13.2	7.4	5.8
Precipitated bone	243.7	7.31	...	93.8	....	...
Sulfate of potash	165.2	4.54	...	....	82.6	...
Carbonate of potash ...	127.1	9.53	...	....	82.6	...
Total	3,100.6	$78.14	200	160.0	200.0	18.8

Plot N6. 1/2 ammonia in dry ground fish.

Carrier Name	Lbs. per acre	Cost an acre	Lbs. plant nutrient per acre NH_3	P_2O_5	K_2O	MgO
Cottonseed meal	731.7	$18.30	60	21.2	10.9	5.1
Castor pomace	294.1	4.41	20	5.3	2.9	2.3
Dry ground fish	957.8	35.92	100	72.7	....	...
Nitrate of soda	106.4	3.61	20	....	....	...
Precipitated bone	158.0	4.74	...	60.8	....	...
Sulfate of potash	169.0	4.65	...	....	84.5	...
Carbonate of potash ..	130.0	9.75	...	....	84.5	...
Double sulfate	66.4	1.16	...	....	17.2	7.5
Total	2,613.4	$82.54	200	160.0	200.0	14.9

Plot N7. 1/2 ammonia in tankage.

Carrier Name	Lbs. per acre	Cost an acre	Lbs. plant nutrient per acre NH_3	P_2O_5	K_2O	MgO
Cottonseed meal	731.7	$18.29	60	21.2	10.9	5.1
Castor pomace	294.1	4.41	20	5.3	2.9	2.3
Nitrate of soda	80.0	3.00	20	....	....	...
Tankage	769.2	21.15	100	53.3	....	...
Precipitated bone	208.3	6.25	...	80.2	....	...
Sulfate of potash	169.0	4.65	...	....	84.5	...
Carbonate of potash ...	130.0	9.75	...	....	84.5	...
Double sulfate	66.4	1.16	...	....	17.2	7.5
Total	2,448.7	$68.66	200	160.0	200.0	14.9

All treatments were in triplicate on the same 1/40 acre plots as in preceding years. Fertilizer was spread by hand in the early morning of May 22, when there was no wind to blow it, and harrowed in immediately. On May 27 the entire field was set with Havana seed plants of the Duncan Bros. strain. All plots were cultivated alike throughout the season, were topped July 20, and harvested August 10, 11, 12. Cutworms were a little worse on the first of the three series of plots and necessitated more restocking there. Otherwise the field was very uniform throughout the season. The N5 plots, however, appeared to be somewhat more backward than the others. Also, plots N3 did not grow quite as well as those adjacent.

All the tobacco in this and the following series was assorted and sampled in the Tobacco Station shop and graded on basis of selected samples by the grading department of the Connecticut Valley Tobacco Association. The price per pound for each plot

was calculated by the accounting department of the Association from the sorting records and the grading. Since the loan value is estimated at one half the value of the tobacco, this figure was doubled for all grades except the dark stemming stock (11½ cents per pound) and brokes and fillers (9 cents). Twelve cents per pound was deducted for sorting, packing and overhead charges on the better grades and 3½ cents for the dark stemming, brokes, and fillers.

The sorting records of the 21 plots are presented below in Table I. The calculated yield per acre, pool record, and net return per acre are given in Table II.

TABLE I. PERCENTAGE OF GRADES IN THE NITROGEN SERIES, 1925.

Plot	Light wrappers	Medium wrappers	Long darks	Dark stemming	Long seconds	17" seconds	15" seconds	Brokes	Fillers
N1	12	9	32	7	19	4	0	11	6
N1*	14	11	29	9	17	3	0	12	5
N1**	8	9	34	6	25	1	0	13	4
N2	9	12	35	5	20	2	0	11	6
N2*	8	15	35	4	18	1	0	14	5
N2**	13	12	35	4	20	3	1	8	4
N3	10	12	36	5	20	2	0	10	5
N3*	12	17	32	5	17	2	0	11	4
N3**	8	11	38	6	19	2	0	11	5
N4	9	12	36	5	20	2	0	11	5
N4*	4	7	37	4	26	1	0	17	4
N4**	5	5	42	4	25	2	0	14	3
N5	7	11	34	6	21	1	0	14	6
N5*	6	8	36	5	20	1	0	19	5
N5**	5	9	36	5	24	1	0	15	5
N6	8	9	37	6	20	1	0	13	6
N6*	7	9	33	6	23	1	0	16	5
N6**	14	11	34	4	21	2	0	11	3
N7	14	14	28	6	20	1	0	12	5
N7*	6	9	38	6	22	2	0	11	6
N7**	11	14	30	5	19	1	0	15	5

* = first replication.
** = second replication.

Discussion of results. The value of any fertilizer ration is measured by the net return per acre after deducting price of the fertilizer, sorting, packing and overhead charges. (It is assumed that no other expenses vary with the fertilizer used although the labor item must be somewhat larger for stripping a higher yielding plot.) Therefore, the value of these seven treatments may be compared by reference to Table II.

When nitrate of soda is used as the mineral source of nitrogen it seems to make little difference whether it furnishes ⅕ of the nitrogen or ½ of it. The differences in acre yield, price per pound, percentage of grades and net return are too small to be of significance. All six plots were graded in Pool A. On the other

TABLE II. SHOWING ACRE YIELD, NET PRICE PER POUND AND NET RETURN PER ACRE, 1925.

Plot	Special form of NH_3(a)		Cost of fert. per acre	Yield per acre (Lbs.)		Net price per lb. (b)		Net return per acre (c)		Pool rating
	Carrier	Lb. NH_3 per A.		Per plot	Average	Per plot	Average	Per plot	Average	
N1	Nitrate sode	40	$75.66	1814		.34245		$545.54		A
N1*	"	"	"	1787	1838	.36065	.34418	568.82	556.42	A
N1**	"	"	"	1914		.32945		554.91		A
N2	"	100	71.70	1729		.33595		509.16		A
N2*	"	"	"	1844	1808	.33385	.34853	543.92	558.99	A
N2**	"	"	"	1851		.37580		623.90		A
N3	Sulf. amm.	40	74.43	1681		.34580		506.86		A
N3*	"	"	"	1975	1811	.37875	.34748	673.60	557.09	A
N3**	"	"	"	1778		.31790		490.80		A
N4	"	100	68.64	1747		.33660		519.40		A
N4*	"	"	"	1945	1913	.26205	.29397	441.05	487.21	B
N4**	"	"	"	2047		.28325		501.17		A
N5	C. S. M. and C. P..	200	78.14	1709		.28520		409.27		B
N5*	"	"	"	1863	1819	.28200	.28840	447.23	446.60	A
N5**	"	"	"	1884		.29800		483.29		A
N6	D. gr. fish	100	82.54	1993		.30675		523.81		A
N6*	"	"	"	1826	1892	.31005	.33220	483.61	543.39	A
N6**	"	"	"	1857		.37980		622.75		A
N7	Tankage	100	68.66	1771		.38855		619.46		A
N7*	"	"	"	1879	1846	.30115	.34893	497.20	574.07	A
N7**	"	"	"	1888		.35710		605.54		A

(a) Cottonseed meal and castor pomace used to complete the formula up to the requirements of 200 lbs ammonia per acre.
(b) After deducting the cost of sorting, packing, sampling and overhead.
(c) After deducting the cost of the fertilizer.

hand, the final figures in the N1 and N2 plots do not show that any significant financial saving resulted in 1925 from the substitution of a larger amount of nitrate. The difference was somewhat larger in 1924. In comparing yields for the four years we find that it has been 60 lbs. less on the N2 plots than on the N1 plots. Neither the sorting records nor the notes which were taken during the sorting indicate that there was any difference in quality between the two. The same was true for the 1923 and 1924 crops, but in 1922 Dr. Chapman considered the N2 tobacco of not quite as good quality as N1.

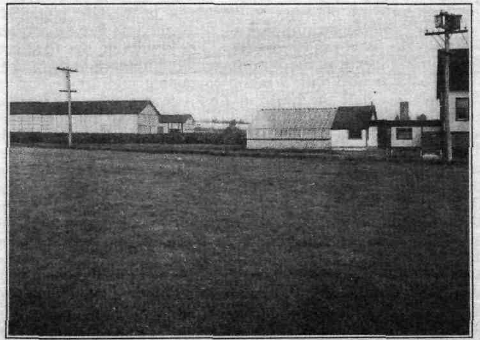

FIG. 2.—General view of station farm showing greenhouse and two of the curing sheds.

Comparing sulfate of ammonia with nitrate of soda as a mineral source of nitrogen we note that the results are about equal when only ⅕ of the nitrogen is from mineral carriers (compare N1 and N3). Neither were any differences in quality observed. When, however, ½ of the ammonia was supplied from sulfate of ammonia the average yield was the highest of any of the plots but the net return was next to the lowest because a smaller percentage of leaves came in the higher grades. In two of these plots there was considerable white-vein which was largely responsible for the lower rating.

When *no* mineral nitrogen-carrier was used (cottonseed meal and castor pomace only—N5), the average yield was next to the lowest and the net return was the lowest of any of the plots. Two of these plots also had considerable white-vein and one

had more than the usual amount of green tobacco. This latter defect accounts for the higher percentage of brokes in N5*. The common belief of tobacco growers that the best quality is secured by the exclusion of all mineral carriers of nitrogen is not supported by the results of this test. It should be remembered, however, that this is only one year's results and that during the preceding three years these plots had *all* their supply of nitrogen from mineral sources.

The plots on which one-half the ammonia was from dry ground fish (N6) produced the heaviest yield, save one, in the whole series. The quality on all of these plots was judged to be very good except for a tendency to light veins in the N6* plot. The net return after deducting cost of fertilizer was $10.83 per acre less than the basal ration plot N1. The results on the 1924 crop were almost identical, the corresponding difference being $10.87.

The plots treated with a ration containing high grade tankage to supply one-half the nitrogen (N7) gave a somewhat higher average yield than the N1 plots. The quality at time of sorting was rated as extra good. It was thin and had no white-vein. The net return after deducting cost of fertilizer was the highest of any of the plots of the nitrogen series, exceeding the N1 plots, by $15.56 per acre. These plots have yielded more tobacco than the N1 plots every year except the first year of the experiment. During the first year the N1 plots yielded over 100 lbs. per acre more than the N7 plots. The average for the four years is about 20 lbs. more for the tankage plots. The use of tankage has been avoided by many because it was thought to contain considerable chlorine. In the chemical analysis of this year's fertilizers made by the chemistry department of the Agricultural Station, it is interesting to note that tankage shows only .31% of chlorine which is about the same as that found in fish or nitrate of soda and less than one-fifth as much as occurs in high-grade sulphate of potash and in double manure salts. Tankage has also been objected to because it produces tobacco which burns with an unpleasant aroma. At the time of writing, the tobacco has not yet come out of the sweat room and therefore the burning qualities of the different plots have not been compared. No data on aroma was secured on the previous crops. This will be discussed in a later report.

Synthetic Urea as a Source of Nitrogen.

Synthetic urea contains a very high percentage of nitrogen (ammonia equivalent, 56%), is prepared from the free nitrogen of the air, contains no residues which could be harmful by accumulation in tobacco soils, and has several advantages if it could be used in tobacco fertilizer mixtures. It has been used with favorable results, on tobacco in Germany. The supply, unlike

that of cottonseed meal, is likely to become more plentiful and it should become less expensive with more general use. The present supply comes from Germany and is put on the market here, after paying the import duty, at about $200 per ton. The cost per unit of ammonia is thns about the same as nitrate of soda and considerably cheaper per unit than cottonseed meal or castor pomace at the prices quoted in the spring of 1925. It is chemically an organic compound but is said to be quickly available like nitrate of soda without being as subject to quick leaching as the latter. Since its effect on the yield and quality of our cigar types is not known, it seemed worth while to start a thorough test at the tobacco station to continue on the same plots for a number of years. This was begun in the season of 1925 and the plots had to be located on a different field from the other nitrogen series. The location proved less favorable, consequently the yields were smaller and more variable. The tobacco from these plots cannot be compared with that from the old nitrogen series but must be compared with check plots on the same field treated with the same ration as the older N1 plots but designated as N1***** and N1******. The plots were in duplicate and two formulas containing urea were used. In one formula urea was the only source of ammonia (N9 and N9*); while in the other formula it was used to supply one-half of the ammonia (N8 and N8*), the other half being in cottonseed meal and castor pomace in the same proportions as in the N1 plots.

The composition of the rations applied to plots N8 and N9 are as follows:

Plot N8. 1/2 ammonia in synthetic urea.

Carrier Name	Lbs. per acre	Cost an acre	Lbs. plant nutrient per acre NH_3	P_2O_5	K_2O	MgO
Cottonseed meal	914.6	$22.87	75	26.5	13.7	6.4
Castor pomace	367.7	5.52	25	6.6	3.7	2.9
Urea	178.4	17.84	100	....	....	...
Precipitated bone	329.6	9.89	...	126.9	....	...
Sulfate of potash	172.0	4.73	...	....	86.0	...
Carbonate of potash ...	132.3	9.92	...	....	86.0	...
Double sulfate	40.7	.71	...	....	10.6	4.6
Total	2,135.3	$71.48	200	160.0	200.0	14.9

Plot N9. All ammonia in synthetic urea.

Carrier Name	Lbs. per acre	Cost an acre	Lbs. plant nutrient per acre NH_3	P_2O_5	K_2O	MgO
Urea	357.0	$35.70	200	....	....	...
Precipitated bone	415.5	12.47	...	160.0	....	...
Sulfate of potash	165.8	4.60	...	....	82.9	...
Carbonate of potash ...	127.4	9.55	...	....	82.8	...
Double sulfate	131.8	2.31	...	....	34.3	14.9
Total	1,197.5	$64.63	200	160.0	200.0	14.9

The fertilizer was applied broadcast on May 23 and the entire field set with Havana seed plants on June 1. Dates of topping, harvesting, stripping and details of sorting and pooling are as above for the nitrogen series. No significant differences in growth or maturity were noted throughout the season. About the middle of the season it was discovered that a part of this field was affected with brown rootrot but the diseased area bore no obvious relation to the fertilizer treatment since it was present in both the check plots and the plots treated with the urea ration. The worst affected areas were eliminated at harvest and not included in calculating the results.

The sorting data on these six plots are presented below in Table III. The price per pound, acre yield, rating and net return per acre are given in Table IV.

TABLE III. PERCENTAGE OF GRADES IN SYNTHETIC UREA PLOTS, 1925.

Plot	Light wrappers	Medium wrappers	Long darks	Dark stemming	Long seconds	17" seconds	15" seconds	Brokes	Fillers
N8	3	6	21	16	20	4	1	19	10
N8*	0	3	35	19	17	6	1	10	9
N9	0	0	26	26	15	2	0	17	14
N9*	3	5	30	16	22	5	2	9	8
N10	12	9	33	5	23	3	1	11	3
N10*	15	6	34	5	21	3	0	12	4
N1***	15	14	33	9	12	5	0	7	5
N1****	12	8	33	9	18	5	1	8	6
N1*****	0	3	26	24	16	5	1	17	9
N1******	12	9	27	16	14	7	2	5	8

At the time of sorting, the quality of the tobacco from the N8 plots (½ ammonia from urea) was judged to be about the same as that from the check plots. The pool rating also indicates the same. The acre yield was approximately the same. The tobacco from the plots where all the ammonia was from urea (N9) was not of such good quality since a much larger percentage of the leaves had prominent and white veins. The pool rating was also lower on these plots.

On account of the small number of replications and the lack of uniformity on this field, it is too early to draw any final conclusions from these tests of one year. The indications up to the present are (1) that urea may be used to supply one-half the ammonia of the fertilizer ration without impairment of quality or yield and that (2) its use as the sole source of ammonia in the mixture reduces the quality of the tobacco as evidenced by white and prominent veins.

CONCENTRATED FERTILIZERS.

That the yield is not reduced but probably increased by the use of urea is indicated by a further test which was made in a small way on another field where the soil was more uniform and the

TABLE IV. SYNTHETIC UREA PLOTS, 1925. ACRE YIELD, POOL RATING, NET PRICE PER POUND, AND NET RETURN PER ACRE.

Plot	Lbs. NH_3 per acre as		Cost of fertilizer	Yield per acre		Pool rating	Net price per lb. (d)		Net return per acre (e)	
	Urea	C. S. meal		Per plot	Average		Per plot	Average	Per plot	Average
N1***** N1******	none "	200 (a) "	$75.66 "	1364 1561	1462	A B	.17840 .29605	.23722	$167.68 368.48	$277.08
N8 N8*	100 "	100 (b) "	71.48 "	1356 1597	1476	A B	24155 .18180	.21167	256.06 219.27	237.66
N9 N9*	200 "	none "	64.63 "	1347 1465	1406	C B	.13755 .23325	.18540	120.65 277.08	198.86
N1*** N1****	none "	200 (a) "	75.66 "	1646 1788	1717	A A	.37120 .33570	.35345	535.33 524.57	529.95
N10 N10*	160 (c) "	none "	60.29 "	1702 1766	1734	B A	.32870 .35990	.34430	499.16 575.29	537.22

(a) 40 lbs. NH_3 per acre as nitrate of soda, 160 lbs. NH_3 as cottonseed meal and castor pomace.
(b) No nitrate in this formula.
(c) 40 lbs. NH_3 as nitrate of potash.
(d) After deducting the cost of sorting, packing, sampling, and overhead.
(e) After deducting cost of fertilizer.

yield good. The original purpose of this experiment was to see what effect a highly concentrated fertilizer would have on the yield and quality of Havana seed tobacco. If our fertilizer mixtures could be reduced to smaller volume and still supply the same quantity of plant nutrients there would be a considerable saving in labor of transportation and application. The formula mixed for this trial was as follows:

Plots N10 and 10. Concentrated formula.*

Carrier Name	Lbs. per acre	Cost per acre	Lbs. plant nutrient—A NH_3	P_2O_5	K_2O
Urea 56%	286	$28.60	160	...	...
Treble superphosphate 40% ..	400	12.00 (a)	...	160	...
Nitrate of potash	267	10.01	40	...	116
Carbonate of potash	129	9.68	...	...	84
Total	1,082	$60.29	200	160	200

(a) Figured at same price as precipitated bone.

This formula furnishes the same amount of nutrients per acre as two tons of a 5-4-5 mixture but the amount of material to be

FIG. 3.—A good type of wagon for drawing tobacco to the sheds. Loaded from the ground. Station farm, 1925.

handled is reduced from 4000 to 1082 lbs. The grade is 18.5-14.8-18.5. In this way possible harmful residues are reduced to a minimum and the acre cost is very low. Duplicate plots (N10

and N10*) were treated with this formula while alternating check plots (N1*** and N1****) received the same basal ration as N1. During the growing season the tobacco on the N10 plots seemed a little more rank in growth and darker green than on the check plots. The harvested weights, however (Table IV), show only a very slight gain for the "concentrated" plots. The sorting records (Table III) show no significant differences in grades but during the sorting it was noted that the tobacco from the N10 plots had a strong tendency to white-veins. A great many leaves otherwise of medium wrapper quality were thrown into cheaper grades because of this defect. No other harmful effects from the use of the concentrated formula were observed at any time during the year. The plants started to grow just as quickly as on the check plots without any evidence of root injury. There was no yellow tobacco to indicate a leaching of the fertilizer or a lack of nitrogen. On the contrary, it has been suggested by the manufacturers of urea that the objectionable prominent veins may be due to an *excess* of nitrogen rather than the *form of the carrier*. They claim for this material that the nitrogen is used by the plant to a greater extent than is the case with such organic substances as cottonseed meal, the ration being about 4:3 in favor of urea. According to this interpretation we should use only about 150 lbs. of ammonia in a urea formula to be compared with our basal ration. The average price per pound calculated by the accounting department of the Association was nearly the same for the check and urea plots. The net return per acre was slightly higher for the urea plots but the difference is too small to be of significance.

The first year's results are surely encouraging enough to warrant further testing of synthetic urea.

Soilgro.

It is claimed by the manufacturers of this product that, although Soilgro is not really a fertilizer, it serves the same purpose because it furnishes and stimulates the growth of certain efficient nitrogen fixing bacteria in the soil. At the tobacco station it was tested during 1925 in three ways:

1. In combination with ½ our basal ration formula.
2. Without any fertilizer.
3. With a full ration of phosphoric acid and potash as in the basal ration but without any source of ammonia, depending on the soilgro to furnish the ammonia.

Some was introduced into the water used at setting time, some was applied to the roots by soaking overnight, some was applied by drenching the soil after the plants started. All three of the methods in combination were tried on some of the plants.

All the plants started well and little difference was noticed during the first three weeks. After that, however, the rows which had received no nitrogen began to lag behind and after some heavy rains in midseason they began to turn yellow and top out short. Only the rows which received the half ration of regular fertilizer kept the normal dark green color. Apparently the addition of phosphoric acid and potash had little if any effect and the soilgro failed to supply the deficiency of nitrogen since these plants were as yellow and starved in appearance as those which received no fertilizer at all. The rows were harvested separately but no sorting records were taken because all of the tobacco except that from the rows treated with regular fertilizer was yellow and lifeless and fit only for brokes. It was sold for stemming without sorting. The tobacco on the regular fertilizer rows was of somewhat less than average quality, probably due to short rations, but was far superior to that which depended on Soilgro.

It was very obvious that this substance is worthless for tobacco. For further tests of Soilgro for other crops, see Journal of Agronomy 17 : 10. 1925.

Phosphoric Acid Series.

The object of this series which has been in progress since 1922 is to determine what *quantity* of phosphoric acid is best for the production of good Havana seed tobacco. (For a more detailed description of the experiment and the results of the first three years' trials, the reader is referred to Tobacco Bulletin No. 5 of this station.) In 1925 the location of plots and the general plan was the same as in the preceding years, but a few minor changes seemed advisable:

1. The check plots (P1) received the same fertilizer ration as the N1 plots in the nitrogen series.
2. Acid phosphate was omitted from the formulas completely, precipitated bone only being used.
3. Ammonia and potash were applied at the basal acre rate of 200 lbs. each to all the plots of this series but phosphoric acid at the rate of 53, 100, 160, and 240 lbs. It was not thought worth while to continue the trial of 306 lbs. per acre, the maximum amount of 1922-24, because the preceding years' trial had shown that the tobacco produced on this ration was inferior to the others.

The plots were on the same field as the nitrogen series and alternated with them. Treatment throughout the season was the same and needs no further description than that given in discussing the nitrogen series. No significant differences in growth or maturity were noticed in these plots during the growing season.

The plots were in triplicate. The fertilizer mixture for each of the four treatments was as follows:

Plot P1. Basal ration with 160 lbs. P_2O_5 per acre.

Carrier Name	Lbs. per acre	Cost an acre	NH_3	P_2O_5	K_2O	MgO
			Lbs. plant nutrient per acre			
Cottonseed meal	1,463.4	$36.59	120	42.4	21.9	10.2
Castor pomace	588.2	8.82	40	10.6	5.9	4.7
Nitrate of soda	212.7	7.23	40	....	....	...
Precipitated bone	277.9	8.34	...	107.0	....	...
Sulfate of potash	172.2	4.74	...	....	86.1	...
Carbonate of potash ...	132.5	9.94	...	....	86.1	...
Total	2,846.9	$75.66	200	160.0	200.0	14.9

Plot P2. Basal ration but no precipitated bone added. 53 lbs. P_2O_5 per acre.

Carrier Name	Lbs. per acre	Cost an acre	NH_3	P_2O_5	K_2O	MgO
			Lbs. plant nutrient per acre			
Cottonseed meal	1,463.4	$36.59	120	42.4	21.9	10.2
Castor pomace	588.2	8.82	40	10.6	5.9	4.7
Nitrate of soda	212.7	7.23	40	....	....	...
Sulfate of potash	172.2	4.74	...	....	86.1	...
Carbonate of potash ...	132.5	9.94	...	....	86.1	...
Total	2,569.0	$67.32	200	53.0	200.0	14.9

Plot P3. Basal ration but with phosphoric acid reduced to 100 lbs. per acre.

Carrier Name	Lbs. per acre	Cost an acre	NH_3	P_2O_5	K_2O	MgO
			Lbs. plant nutrient per acre			
Cottonseed meal	1,463.4	$36.59	120	42.4	21.9	10.2
Castor pomace	588.2	8.82	40	10.6	5.9	4.7
Nitrate of soda	212.7	7.23	40	....	....	...
Precipitated bone	122.1	3.66	...	47.0	....	...
Sulfate of potash	172.2	4.74	...	....	86.1	...
Carbonate of potash ...	132.5	9.94	...	....	86.1	...
Total	2,691.1	$70.98	200	100.0	200.0	14.9

Plot P4. Basal ration with 240 lbs. P_2O_5 per acre.

Carrier Name	Lbs. per acre	Cost an acre	NH_3	P_2O_5	K_2O	MgO
			Lbs. plant nutrient per acre			
Cottonseed meal	1,463.4	$36.59	120	42.4	21.9	10.2
Castor pomace	588.2	8.82	40	10.6	5.9	4.7
Nitrate of soda	212.7	7.23	40	....	....	...
Precipitated bone	485.7	14.57	...	187.0	....	...
Sulfate of potash	172.2	4.74	...	....	86.1	...
Carbonate of potash ...	132.0	9.94	...	....	86.1	...
Total	3,054.2	$81.89	200	240.0	200.0	14.9

The sorting records are presented in Table V and the acre yield, pool rating, price per pound and net returns in Table VI.

TABLE V. PERCENTAGE OF GRADES IN THE PHOSPHORIC ACID PLOTS, 1925

Plot	Light wrappers	Medium wrappers	Long darks	Dark stemming	Long seconds	17" seconds	15" seconds	Brokes	Fillers
P1	17	16	27	7	14	4	0	10	5
P1*	6	5	35	6	22	1	0	20	5
P1**	11	11	26	12	16	5	2	9	8
P2	14	17	29	5	18	2	0	10	5
P2*	7	10	34	8	21	2	0	13	5
P2**	10	13	24	13	17	5	1	10	7
P3	10	10	26	9	23	3	0	14	5
P3*	8	7	35	6	25	2	1	11	5
P3**	6	5	32	14	23	4	2	8	6
P4	11	12	30	9	19	2	0	11	6
P4*	8	7	35	6	23	2	0	12	7
P4**	10	14	26	11	22	1	0	9	7

Examination at the time of sorting showed the quality to be very good on nearly all the twelve plots. Some light vein was noted only in Plots P3*, P3** and P4. The tobacco with the highest percentage of phosphoric acid was compared carefully for objectionable red or double colors. It was the general opinion both in the sorting shop and at the grading department that the dark wrappers did show more of a cinnamon red than the other plots but there was no objectionable red or double color. Neither was the tobacco from the plots which received the least phosphorus objectionably green.

It seems rather significant that the tobacco from the low phosphorus plots (P2 plots) not only were rated the best at time of sorting, but also were pooled highest by the Association grading department. This not only gave as high a yield as any of the other treatments, but had the highest average price per pound and the lowest fertilizer cost. In addition, the net acre return was $51.03 higher than from any other plots.

In view of the good showing of these plots at the end of 4 years without any phosphoric acid other than that in the cottonseed meal and castor pomace, and in view of their record during the preceding three years when they were so near the top in yield, quality and net return that they were well within the range of experimental error, one could be pardoned for questioning the need of any additional phosphoric acid in the fertilizer on this soil. Analyses of this soil by Professor Morgan of the Soils Department of the Station indicate it to be well supplied with fairly available phosphorus. Certainly it would be safe on the station plots to cut down the application considerably below our basal rate of 160 lbs. per acre. There are probably many other tobacco soils which are annually oversupplied with phosphoric acid. A few growers of good tobacco have told the writers that they have omitted special carriers of phosphoric acid from their fertilizer for one or more years without injurious results. It is conceivable, however, that the continuous omission of phosphorus through a long series of years might deplete the soil to

TABLE VI. PHOSPHORIC ACID PLOTS, 1925. POOL RATING, ACRE YIELD, NET PRICE PER POUND, AND NET RETURN PER ACRE.

Plot	Lbs. P_2O_5 per acre	Cost of fertilizer	Yield per acre		Pool rating	Net price per lb. (a)		Net return per acre (b)	
			Per plot	Average		Per plot	Average	Per plot	Average
P2	53	$67.32	1879	1812	A	.40005	.34953	$684.37	$566.86
P2*	"	"	1885		A	.30980		516.65	
P2**	"	"	1673		A	.33875		499.57	
P3	100	70.98	1742	1785	A	.34395	.30865	528.18	472.32
P3*	"	"	1899		A	.32070		538.03	
P3**	"	"	1614		B	.26130		350.75	
P1	160	75.66	1894	1788	A	.40545	.32648	692.26	512.10
P1*	"	"	1753		A	.27235		401.77	
P1**	"	"	1717		B	.30165		442.27	
P4	240	81.89	1826	1814	A	.34745	.32777	552.55	515.83
P4*	"	"	1886		A	.30995		512.68	
P4**	"	"	1731		B	.32590		482.25	

(a) After deducting cost of sorting, packing, sampling and overhead.
(b) After deducting cost of fertilizer.

an extent which would be unfavorable for the best growth of tobacco. Furthermore it is not safe to conclude that all the Connecticut Valley tobacco soils would be as indifferent to phosphoric acid fertilizers as the soil of this field at the tobacco station.

The Old Potash Series.

The purpose of the old potash series was to compare sulfate of potash with double sulfate of potash and magnesia as sources of potash in the fertilizer ration. (See Tobacco Station Bulletin 5, p. 24 for a more detailed discussion.) The three plots have been in duplicate on the same field as the nitrogen plots for three years. Location of plots for 1925 and the general plan of the experiment was the same as in the previous years. The only modifications made were the reduction of quantity of fertilizer applied per acre to 200-160-200 of ammonia, phosphoric acid and potash respectively, as previously explained under the other series and the elimination of acid phosphate. The composition of the mixtures was as follows:

Plot K1. Basal ration with all mineral potash in sulfate of potash.

Carrier Name	Lbs. per acre	Cost an acre	Lbs. plant nutrient per acre NH_3	P_2O_5	K_2O	MgO
Cottonseed meal	1,463.4	$36.59	120	42.4	21.9	10.2
Castor pomace	588.2	8.82	40	10.6	5.9	4.7
Nitrate of soda	212.7	7.23	40	....	....	...
Precipitated bone	277.9	8.34	...	107.0	....	...
Sulfate of potash	344.4	9.47	...	....	172.2	...
Total	2,886.6	$70.45	200	160.0	200.0	14.9

Plot K2. Basal ration with all mineral potash in double sulfate of potash and magnesia.

Carrier Name	Lbs. per acre	Cost an acre	Lbs. plant nutrient per acre NH_3	P_2O_5	K_2O	MgO
Cottonseed meal	1,463.4	$36.59	120	42.4	21.9	10.2
Castor pomace	588.2	8.82	40	10.6	5.9	4.7
Nitrate of soda	212.7	7.23	40	....	....	...
Precipitated bone	277.9	8.34	...	107.0	....	...
Double sulfate	662.3	11.59	...	....	172.2	74.8
Total	3,204.5	$72.57	200	160.0	200 0	89.7

Plot K3. Basal ration with mineral potash, 1/2 in High Grade sulfate and 1/2 in double sulfate of potash and magnesia.

Carrier Name	Lbs. per acre	Cost an acre	Lbs. plant nutrient per acre NH_3	P_2O_5	K_2O	MgO
Cottonseed meal	1,463.4	$36.59	120	42.4	21.9	10.2
Castor pomace	588.2	8.82	40	10.6	5.9	4.7
Nitrate of soda	212.7	7.23	40	....	....	...
Precipitated bone	277.9	8.34	...	107.0	....	...
Sulfate of potash	172.2	4.74	...	....	86.1	...
Double sulfate	331.2	5.80	...	....	86.1	37.4
Total	3,045.6	$71.52	200	160.0	200.0	52.3

All cultural operations were the same as described previously for the other fertilizer experiments.

The sorting records for the plots are presented in Table VII and the acre yields, pool ratings, average price per pound, and net acre returns are given in Table VIII.

TABLE VII. POTASH SERIES, 1925. PERCENTAGE OF GRADES.

Plot	Light wrappers	Medium wrappers	Long darks	Dark stemming	Long seconds	17" seconds	15" seconds	Brokes	Fillers
K1	14	17	29	5	19	3	0	8	5
K1*	16	14	30	5	18	3	0	8	6
K2	15	16	33	4	17	3	0	8	4
K2*	15	17	23	6	19	2	0	12	6
K3	13	10	33	4	24	2	0	9	5
K3*	14	19	25	6	20	3	0	8	5
K4	2	2	24	19	18	6	1	18	10
K4*	13	7	24	16	14	5	1	13	7
K5	4	4	21	18	15	4	1	24	9
K5*	11	11	24	15	13	4	1	17	4
K6	3	2	45	7	24	4	1	11	3
K6*	2	4	44	12	20	5	1	8	4
K7	11	11	20	18	13	6	1	13	7
K7*	11	8	22	17	16	5	1	13	7
K8	5	9	27	16	19	5	1	15	3
K8*	10	10	25	11	15	4	1	17	7
K9	4	4	29	15	23	4	2	13	6
K9*	10	9	31	12	10	4	2	16	6
K10	3	3	18	18	18	3	0	26	11
K10*	7	6	30	11	24	2	0	15	5

No differences in growth were noticed on these plots (K1, 2 and 3) during the summer. The growth was rapid and uniform from the first. Nothing resembling magnesia hunger was observed on any of these plots at any time. At the time of sorting, the quality of the tobacco from all the plots was rated as excellent. The leaves were thin and there were no evidences of white-vein, premature yellowing, or dead tobacco on any of the plots. All were put in the A grade by the Association grading department. The percentage of light and medium wrappers was uniformly high as was also the calculated average price per pound. Differences among them are too small to be of significance. The highest yield and highest net return per acre were on the plots treated with high grade sulfate. The lowest yield and lowest net return per acre were on the plots treated with double manure salts. The plots treated with a mixture of the two yielded midway between the others. The average yields for the three years of the experiment are: High grade sulfate, 1824; double manure salts, 1764; combination of the two, 1806.

Although the differences between the three are rather small, they have been in favor of the high grade sulfate during two out of the three years of the experiment. The main reason advanced

TABLE VIII. POTASH SERIES, 1925. POOL RATING, YIELD PER ACRE, NET PRICE PER POUND, AND NET RETURN PER ACRE.

Plot	K_2O applied (a)		Cost of fertilizer	Yield per acre		Pool rating	Net price per lb.		Net return per acre	
	as	Lbs. per acre		Per plot	Average		Per plot	Average	Per plot	Average
K1	K_2SO_4	172.2	$70.45	2054		A	.40665		$764.81	
K1*	"	"	"	2061	2057	A	.40230	.40447	758.70	$761.75
K2	Doub. sulf.	"	72.57	1932		A	.39530		691.14	
K2*	"	"	"	1892	1912	A	.41040	.40285	703.91	697.52
K3	{ K_2SO_4 / Doub. sulf. }	{ 86.1 / 86.1 }	71.52	2029		A	.37790		695.24	
K3*	"	"	"	1929	1979	A	.42155	.39972	741.65	718.44
K4	K_2SO_4	172.2	70.46	1418		B	.19010		199.10	
K4*	"	"	"	1553	1486	C	.26260	.22635	337.36	268.23
K5	K_2CO_3	"	80.86	1425		B	.19875		202.36	
K5*	"	"		1545	1485	B	.28580	.24227	360.70	282.53
K7	{ K NO_3 / K_2CO_3 }	{ 115.7 / 56.5 }	70.19	1434		B	.28750		342.09	
K7*	"	"	"	1695	1570	B	.28380	.28565	410.85	376.47
K8	{ K_2SO_4 / K_2CO_3 }	{ 86.1 / 86.1 }	75.66	1458		B	.25530		296.57	
K8*	"	"	"	1497	1478	C	.25680	.25605	308.77	302.67
K9	{ K_2SO_4 / K_2CO_3 / K NO_3 }	{ 57.4 / 57.4 / 57.4 }	72.14	1563		C	.21915		270.39	
K9*	"	"	"	1524	1544	A	.28430	.25172	361.13	315.76
K10	Marl	?		1324		C	.16230			
K10*	"	"		1641	1483	C	.25305	.20767		
K6	K Cl	172.2		1685		B	.24315			
K6*	"	"		1799	1742	B	.22820	.23567		

(a) Balance of potash (27.8 lbs. K_2O per acre) supplied in C. S. meal and castor pomace.

NOTE: K1, K2, and K3 are the old potash plots in field No. 1.
Treatments K4, K5, K7, K8, and K9 are in a different field and were begun in 1925.

for using double sulfate, however, is that it prevents the chlorotic condition of the plants commonly known as "sand-drown" or magnesia hunger. If, however, the grower uses considerable organic material such as cottonseed meal or castor pomace in his fertilizer mixture, as most growers do, he will have enough magnesia present and there would seem to be no need for using double manure salts. Our basal ration without any double manure salts contains about 15 pounds of magnesia to the acre and this seems to be sufficient to satisfy the needs of the plant for this material since magnesia hunger has not been observed on any plots which had that amount applied. The absence of magnesium starvation cannot be explained satisfactorily on the ground that this soil naturally contains a sufficient supply of available magnesia. We have two excellent demonstrations that the case is quite the contrary: (1) Within a distance of less than five rods from the old potash plots there is a series of plots on which "magnesia hunger" is being studied. Certain of these plots have not received any magnesia for four years. During the season of 1925 these plots were seriously affected with magnesia hunger. The same plots had magnesia hunger three years previously. (2) In the old nitrogen series there were certain plots (N3 and N5) which formerly received all their nitrogen in mineral carriers, and none of the fertilizer ingredients had more than a trace of magnesia. These plots were affected with magnesia hunger in 1922 (Bulletin 5, p. 8).

Summarizing the results of the old potash series we may say that up to the present no reason for substituting double manure salts for high grade sulfate has been found, either from the standpoint of preventing chlorosis or from the standpoint of improvement of quality or increase in yield. If, for any reason, a grower planned to reduce to a very low percentage the amount of cottonseed meal or other organic carrier of magnesium applied to the soil, it is conceivable that a mineral magnesia carrier would be advisable. But as long as the growers continue to apply manure, cottonseed meal, castor pomace, linseed meal, fish, wood ashes and tobacco stems in the quantities now used, there would seem to be some disadvantages and no real advantages in using the double sulfate of potash and magnesia.

The New Potash Series.

There are other carriers of potash besides high grade sulfate and double manure salts which may be used in fertilizer mixtures. The most important of these is carbonate. Nitrate may also be used but, as previously mentioned, the supply of this material is uncertain. There is pretty good evidence that aside from muriate, the worst form in which we can supply potash is sulfate (either in high grade or double sulfate), especially if we wish to improve the quality of our tobacco rather than to increase the

yield. In the five years fertilizer experiment at Poquonock, 1892-96, it was found that the best quality of tobacco was produced on those plots which had the potash supplied in the form of carbonate, although the highest yields were produced where the sulfate was used. Later chemical work by Garner (U. S. D. A., B. P. I., Bulletin No. 105, 1907) indicates that the burn is greatly influenced by the ratio of sulfate and potash and that an excess of sulfate in the leaf should be avoided. The compounds in the leaf, which are of importance in producing good burn, are the potash salts of the organic acids, such as malate and

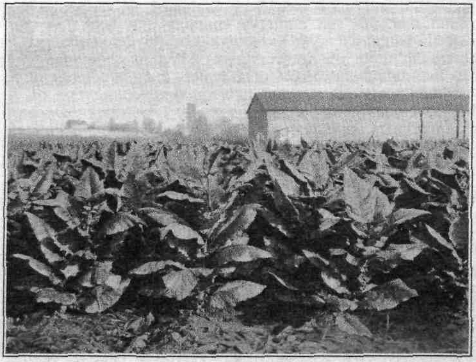

FIG. 4.—Duncan Brothers type of Havana Seed. Tobacco station farm, 1925.

citrate; but these salts are formed only from the potash which remains over after mineral radicals, such as the sulfates, have been neutralized. Hence, it is advisable to reduce, as much as possible, the sulfates supplied to the plant. The advantage of using carbonate of potash probably lies in the fact that it introduces potash without an unnecessary or harmful quantity of sulfates. In former years large quantities of carbonate were used on tobacco land mostly in such carriers as cotton hull ashes or wood ashes, but also to some extent as pure carbonate. Old tobacco growers state that the leaf grown in those days was superior in quality and burn to that which we raise now. It is rather difficult to prove that such was really the case and that

such superiority, if real, was due to the form in which the potash was supplied.

In view of the favorable influence of carbonate of potash on quality, why is it that nearly all fertilizer mixtures have their potash in the form of sulfate and why do most growers who mix their own fertilizers use sulfate? There are at least three contributing reasons (1) Cotton hull ashes, which was the standard source of carbonate of potash, went off the market. (2) Pure carbonate is an expensive form of potash. (3) Black rootrot was said to be favored through the use of carbonate.

The seriousness of the black rootrot menace first became apparent and attracted wide attention during the first decade of the century. Growers had been using large quantities of carbonate of potash and when it was found that an alkaline condition of the soil favored development of the disease, considerable blame was laid on the carbonate. Is it not more likely that the preceding era of heavy liming had more to do with bringing the tobacco field into this condition than the carbonate of potash? Canada ashes and cotton hull ashes also contain considerable lime in addition to carbonate of potash. Plant pathologists and other agricultural experts advised so strongly against carbonate that growers and fertilizer manufacturers have now almost ceased to use it. Meanwhile the tobacco soils have been dosed for many years with large quantities of sulfate.

One of the main objects of the potash series was to determine what effect a yearly application of the required potash in the form of pure carbonate would have on the reaction of the soil. During the last year we have determined pretty definitely the degree of acidity which is necessary in a soil in order to prevent rootrot. Most of the tobacco soils are so acid that there would seem to be little likelihood of reducing the acidity to a dangerous degree by the annual application of carbonate of potash to supply 200 lbs. of potash per acre. In order to test this, a new series of plots was laid out on a different part of the experiment station farm where tobacco has been grown for many years. This field is not so favorable for growing tobacco as the field where the old fertilizer plots are located. The soil is a lighter sand, more inclined to leaching ,and has never produced as much or as good tobacco. The plots are 1/40 acre in size and in duplicate. The fertilizer rations applied to each are as follows:

Plot K4. All mineral potash in H. G. sulfate.

Carrier Name	Lbs. per acre	Lbs. per 1/40 acre	Cost an acre	Lbs. plant nutrient per acre NH_3	P_2O_5	K_2O	MgO
Cottonseed meal	1,463.4	36.6	$36.59	120	42.4	21.9	10.2
Castor pomace	588.2	14.7	8.82	40	10.6	5.9	4.7
Nitrate of soda	212.7	5.3	7.23	40	...	...	...
Precipitated bone ..	277.9	6.9	8.34	...	107.0	...	...
Sulfate of potash ..	344.4	8.6	9.48	...	...	172.2	...
Total	2,886.6	72.1	$70.46	200	160.0	200.0	14.9

Plot K5. All mineral potash in carbonate.

Carrier Name	Lbs. per acre	Lbs. per 1/40 acre	Cost an acre	Lbs. plant nutrient per acre NH_3	P_2O_5	K_2O	MgO
Cottonseed meal	1,463.4	36.6	$36.59	120	42.4	21.9	10.2
Castor pomace	588.2	14.7	8.82	40	10.6	5.9	4.7
Nitrate of soda	212.7	5.3	7.23	40	...	...	...
Precipitated bone ..	277.9	6.9	8.34	...	107.0	...	...
Carbonate of potash.	265.0	6.6	19.88	...	...	172.2	...
Total	2,807.2	70.1	$80.86	200	160.0	200.0	14.9

Plot K7. 2/3 mineral potash in nitrate; 1/3 in carbonate.

Carrier Name	Lbs. per acre	Lbs. per 1/40 acre	Cost an acre	Lbs. plant nutrient per acre NH_3	P_2O_5	K_2O	MgO
Cottonseed meal	1,463.4	36.6	$36.59	120	42.4	21.9	10.2
Castor pomace	588.2	14.7	8.82	40	10.6	5.9	4.7
Nitrate of potash ...	266.6	6.7	9.92	40	...	115.7	...
Precipitated bone ..	277.9	6.9	8.34	...	107.0	...	...
Carbonate of potash.	87.0	2.2	6.52	...	...	56.5	...
Total	2,683.1	67.1	$70.19	200	160.0	200.0	14.9

Plot K8. Mineral potash divided equally between sulfate and carbonate of potash.

Carrier Name	Lbs. per acre	Lbs. per 1/40 acre	Cost an acre	Lbs. plant nutrient per acre NH_3	P_2O_5	K_2O	MgO
Cottonseed meal	1,463.4	36.6	$36.59	120	42.4	21.9	10.2
Castor pomace	588.2	14.7	8.82	40	10.6	5.9	4.7
Nitrate of soda	212.7	5.3	7.23	40	...	...	...
Precipitated bone ..	277.9	6.9	8.34	...	107.0	...	...
Sulfate of potash ..	172.2	4.3	4.74	...	...	86.1	...
Carbonate of potash.	132.5	3.3	9.94	...	...	86.1	...
Total	2,846.9	71.1	$75.66	200	160.0	200.0	14.9

Plot K9. Mineral potash divided equally between sulfate, nitrate, and carbonate.

Carrier Name	Lbs. per acre	Lbs. per 1/40 acre	Cost an acre	Lbs. plant nutrient per acre NH_3	P_2O_5	K_2O	MgO
Cottonseed meal	1,463.4	36.6	$36.59	120.0	42.4	21.9	...
Castor pomace.	588.2	14.7	8.82	40.0	10.6	5.9	...
Nitrate of soda	107.4	2.7	3.65	20.2	...	...	...
Precipitated bone ..	277.9	6.9	8.34	...	107.0	...	...
Sulfate of potash ...	114.8	2.9	3.16	...	...	57.4	...
Carbonate of potash.	88.3	2.2	6.62	...	...	57.4	...
Nitrate of potash ...	132.3	3.3	4.96	19.8	...	57.4	...
Total	2,772.3	69.3	$72.14	200.0	160.0	200.0	...

It will be noted from the above that not only carbonate, sulfate and nitrate are being tested but various combinations of them.

No significant differences in growth were observed during 1925, the first year of the experiment. After the heavy rains in July there was considerable indication of leaching and the lower leaves showed considerable yellowing before harvest.

Growth was not entirely satisfactory; and besides, a spotting of the lower leaves resembling in all outward symptoms the southern bacterial disease, "angular leaf spot," caused considerable damage on one end of the field.

All sorting and pooling data are presented in Tables VII and VIII.

Comparison during the sorting placed the tobacco from the sulfate plots (K4) as the poorest of all. The leaves were inclined to be yellow, boardy, and lacking in life and elasticity. The plots having carbonate of potash alone (K5) were of better quality and the net return was higher although the yield was about the same. The highest yield and highest net return per acre were on the plots where ⅔ of the mineral potash was from nitrate and the other third from carbonate (K7 and K7*). (It was not possible to use nitrate as the only source of potash because the mineral nitrogen would thus have been raised above the requirements of the formula.) The average price was also highest on these and at the time of sorting the quality of both was rated as good. The plot, however, which rated highest was K9*. This tobacco was thin, elastic and showed no white-vein nor yellowing. Angular leaf spot was more serious on this than on any of the other plots in this field, and was responsible for the high percentage of brokes. Otherwise it would have made a much better showing. The duplicate plot K9, however, was not considered as good. Since this was the first year of the experiment and the growth on all the plots was not considered entirely satisfactory, it is best not to draw any conclusions.

The effect of the different carriers of potash on the reaction of the soil is of interest and importance. In May, before the fertilizers were applied, samples of the soil from each plot were taken and the reaction tested. Again in September after the crop was harvested, the soil was tested. Without presenting the results of these tests in detail it may be stated that the change in acidity on any of the plots was not perceptible within the limitations of the method. It will be necessary, however, to continue the determinations on the same plots through a series of years before generalizing on the effects of using different potash carriers on tobacco soils.

Soil tests on the fertilizer plots at the Rhode Island Station (R. I. Bul. 189) after 26 years of application of carbonate of potash and of soda are sometimes cited as proving that carbonate of potash has a strong tendency to make the soil alkaline. It should be noted, however, that in addition to the regular ration of carbonate of potash, these plots received a heavy application of carbonate of soda (620 lbs. per acre during the spring when the tests were made).

In view of the natural leaching of certain basic elements in average soils and the amount of potash which is removed by the

tobacco crop every year, there would seem to be little danger of so reducing the acidity as to bring on rootrot by the annual application of two to three hundred pounds of potassium carbonate per acre. A long series of years of this treatment, however, might endanger some soils. Carbonate should be avoided on low, heavy soils where the seepage water from higher ground is apt to stand and from which there is little leaching. In many tests which were made during the past few seasons in tobacco fields it has been found that such low spots in the field are more alkaline than the lighter, higher soils and that rootrot is most serious in such places.

Greensand marl. This is a natural sand containing from 5 to 7% potash. It is claimed by the producers that it also furnishes sufficient phosphoric acid and that the addition of nitrogen is not necessary. Tests during 1923 and 1924 on plots where this was the only fertilizer used showed that it did not possess enough available plant nutrients to produce a normal development of tobacco. It was thought best in the tests of 1925 to supplement it by the addition of cottonseed meal. A mixture was therefore applied at the rate of 3200 lbs. of greensand marl and 800 lbs. of cottonseed meal per acre. The two plots (K10 and K10*) thus treated were in the same field and adjacent to plots N1*** and N1****. The results on the marl plots should be compared with these check plots and not with the other potash plots which were in a different field. The sorting records of the two marl plots and checks along with the yields and net return per acre are presented in Table IX.

TABLE IX. GREENSAND MARL AND CHECK PLOTS.

Plot	Percentage of grades: M. W. and L. W.	Long darks	Dark stem	Long sec.	Short sec.	Fillers & brokes	Pool rating	Yield per acre	Average price per. lb.	Net return after deducting sorting charge
K10	6	18	18	18	3	37	C	1324	.25230	$237.07
K10*	13	30	11	24	2	20	C	1641	.34305	409.27
N1***	29	33	9	12	5	12	A	1646	.47335	610.99
N1****	20	33	9	18	6	14	A	1788	.43615	600.23

These data show that the check plots sorted out with more high grades, the quality was rated higher, the acre yield and average price were higher than the marl plots. The net return was nearly $300 less per acre on the marl plots. The addition of marl as a source of potash would make the mixture too bulky and the expense would be no less than that of using a higher grade potash carrier.

FRACTIONAL APPLICATION SERIES.

The two objects of this series were (1) to determine whether a given amount of fertilizer is more efficient when applied all at

once or when only ⅓ of it is applied before setting, ⅓ as soon as the plants are well started and ⅓ two weeks later; (2) to compare a full ration applied at setting with a reduced amonnt applied fractionally. The plots were in duplicate on the same field as the nitrogen series with the exception of F4 and its duplicate which were on the same field as N1*** and N1**** and these must be compared with the latter plots.

Formulas for the mixtures are as follows:

Plot F1. Same as N2 but plant food reduced to 150-120-150 and applied in three applications.

Carrier Name	Lbs. per acre	Cost an acre	Lbs. plant nutrient per acre NH_3	P_2O_5	K_2O	MgO
Cottonseed meal	685.9	$17.15	56.25	19.9	10.3	4.8
Castor pomace	275.8	4.14	18.75	4.9	3.8	2.2
Nitrate of soda	398.5	13.54	75.00	...	...	...
Precipitated bone	247.2	7.42	....	95.2	...	...
Sulfate of potash	129.0	3.55	....	...	64.5	...
Carbonate of potash ..	99.2	7.44	....	...	64.5	...
Double sulfate	30.4	.53	....	...	7.9	3.5
Total	1,866.0	$53.77	150.0	120.0	150.0	10.5

Plot F2. Same as F1 but all applied broadcast before setting.

Plot F3. Same as N2 but plant food reduced to 125-100-125 and applied in one application.

Carrier Name	Lbs. per acre	Cost an acre	Lbs. plant nutrient per acre NH_3	P_2O_5	K_2O	MgO
Cottonseed meal	571.6	$14.29	46.9	16.6	8.5	4.0
Castor pomace	229.8	3.45	15.6	4.1	2.3	1.8
Nitrate of soda	332.1	11.29	62.5	...	...	...
Precipitated bone	206.0	6.18	....	79.3	...	...
Sulfate of potash	107.5	2.96	....	...	53.8	...
Carbonate of potash ..	82.7	6.20	....	...	53.8	...
Double sulfate	25.4	.44	....	...	6.6	2.9
Total	1,555.1	$44.81	125.0	100.0	125.0	8.7

Plot F4. Same formula as F3 applied fractionally in three applications.

Sorting records for these plots are presented in Table X and the pool ratings, average price, acre yield, and net return per acre, are in Table XI.

TABLE X. FRACTIONAL APPLICATION PLOTS. SORTING RECORDS, 1925.

Plot	Light wrappers	Medium wrappers	Long darks	Dark stemming	Long seconds	17" seconds	15" seconds	Brokes	Fillers
F1	4	5	28	13	17	2	0	23	8
F1*	3	11	29	9	21	2	0	17	8
F2	6	12	24	14	14	2	0	19	9
F2*	8	12	25	10	18	0	0	20	7
F3	4	8	30	12	14	3	0	23	6
F4	20	17	27	10	8	6	2	7	3
F4*	17	10	31	5	17	3	1	11	5

TABLE XI. FRACTIONAL APPLICATION SERIES, 1925. POOL RATING, YIELD, NET PRICE PER POUND AND NET RETURN PER ACRE.

Plot	Method of application	Lbs. plant nutrient per acre			Cost of fertilizer per acre	Yield per acre (lbs.)		Pool Rating	Net price per lb.		Net return per acre	
		NH_3	P_2O_5	K_2O		Per plot	Average		Per plot	Average	Per plot	Average
F1	Fractional (three)	150	120	150	$53.77	1607	1747	B	.21145	.24375	$284.18	$375.66
F1*	" "	"	"	"	"	1887		A	.27605		467.15	
F2	Broadcast (single)	"	"	"	"	1592	1645	A	.27480	.27702	383.71	402.19
F2*	" "	"	"	"	"	1699		B	.27925		420.67	
F3	" "	125	100	125	44.81	1667	1667	B	.21725	.21725	317.34	317.34
F4 (a)	Fractional (three)	"	"	"	"	1650	1746	B	.37530	.36135	574.44	584.77
F4* (a)	" "	"	"	"	"	1842		B	.34740		595.10	

(a) These two plots were on a different field and compared favorably with the check plots N1*** and N1****. (See Table IX.)

The duplicate plots F1 received exactly the same mixture and quantity as duplicate plots F2, the only difference being that the fertilizer on F1 was applied in three different portions while that on F2 was applied broadcast all at once at the time of fitting the ground. Comparing the average net return, however, we find that there has not been a gain but an actual loss of $17.09 per acre from the fractional application besides the extra expense of the labor for making the three applications. In 1924 there was an advantage for the fractional application of $4.01 per acre which would not pay for the extra work. In 1923 the advantage was with the single broadcast application.

Three years of testing on these same plots have failed to show that there is anything to be gained by dividing the fertilizer and making later applications. It was suggested, in writing up the results of the 1924 tests, that perhaps the results would be more favorable for fractional application during a season of more rainfall. But the rainfall in 1925 was above the average and still the results were less favorable for fractional application than in the preceding year. It does not necessarily follow, however, that the results would be the same on all tobacco fields. The soil where these plots are located is not of the light "leachy" type where one might expect the greatest benefit from fractional application. It is planned to repeat these tests during 1926 on such a soil.

The effect of *reducing the amount* of fertilizer is indicated by comparing plots F2 and F3. It will be noted that the saving in cost of fertilizer was more than counterbalanced by the reduction in net return. Effects of reducing the application for three years in succession may be seen by comparing Plot F2* with Plot K1 of the potash series. These two plots are immediately adjacent, being separated by only one row of tobacco. The differences in proportions of ingredients in the mixtures applied were very slight, but K1 received ammonia, phosphoric acid and potash at the basal rate of 200-160-200 while F2* received the same at the reduced rate of 150-120-150. The differences were in about the same proportion during the two preceding years. The net return of this year for the K1 plot was $764.85 as contrasted with a net return of $423.68 for the F2* plot.

The F4 plots were on a different field and were only started in 1925 after heavy applications in the dry year of 1924, hence the results are not comparable with the other plots of the fractional application series. The N1 plots on this field, however, averaged a net return of only $529.96 per acre, as compared with $584.77 from the fractional plots.

SOME GENERAL CONSIDERATIONS ON TOBACCO FERTILIZERS.

Four plant nutrients which must be furnished in the tobacco fertilizer are ammonia, phosphoric acid, potash, and magnesia. These four materials are not purchased in a "free" condition but each is a part of some common substance known as a "carrier." Any one of the four may be supplied in a variety of carriers; e. g., ammonia may be supplied in cottonseed meal, fish, nitrate of soda, or a dozen other carriers. Or, one carrier may furnish more than one element, e. g. cottonseed meal furnishes all four of them.

In deciding on the fertilizer to be used, the grower is confronted with two questions: (1) How much of these nutrients shall be applied to each acre? (2) What carriers can be used to the best advantage in the mixture? In the light of the experiments described in the preceding pages let us try to answer simply and briefly these two questions:

How Much Fertilizer Should Be Used?

It is unfortunate that many growers still think of their fertilizer applications only in terms of the number of pounds of total mixture which they spread on an acre. Such a practice is largely responsible for the inclusion of large quantities of useless "filler" in the mixture by fertilizer manufacturers. By doing this they can furnish a large bulk of mixture at a low price but the bulk applied to an acre does not necessarily bear any definite relation to the amount of nutrients furnished, their chemical form, or the nature of the carriers. The grower should think of his fertilizers in terms of the amount of nutrients supplied to each acre of tobacco without any regard to the weight of the mixture.

Ammonia. During the first three years of the experiments the quantity of ammonia in the standard mixture was about 260 pounds per acre. When this was reduced, the loss in yield and net return more than counterbalanced the saving in fertilizer cost. The same principle held in 1925 when we experimented with applications less than 200 lbs. It will be noticed in the tables presented in the preceding pages that the plots which produced the *most* tobacco also usually produced the *best* tobacco, i. e., there was a larger proportion of leaves in the higher grades and the average price was correspondingly high. The impression of many that a big growth of tobacco produces a heavy inferior leaf is not borne out by the actual sorting records on these experiments up to date. This was also the conclusion of Dr. Jenkins after the five-year Poquonock experiment of thirty years ago. In those experiments it may also be mentioned that it was found profitable to increase the nitrogen to 210 pounds

(255 lbs. ammonia per acre). On the basis of experiments up to date and supplementary experience of many successful growers, we are led to believe that the proper amount of ammonia to be applied is in the neighborhood of 250 pounds per acre. It has been previously mentioned, however, that different fields may vary markedly as to fertilizer needs. Intelligent experience is the best guide for any grower and if years of experience have proved that he can raise the best tobacco on some of his fields with less than 250 lbs, while others need more, he will do well to avoid too radical a change. Those who think this amount too expensive should consider that there is money in outdoor tobacco only in the big yield. On the average it takes 1500 pounds of tobacco to pay the expenses of producing. The money the grower gets for those pounds in excess of that amount is his profit. He cannot afford to neglect any practice which will add to that excess. When pounds are all profit it does not take many to pay for a little extra fertilizer.

Phosphoric acid. The fact that we can grow the best tobacco where no mineral phosphorus carrier has been used for four years leads us to believe that many old tobacco fields are consistently oversupplied with that element. Although we are not ready to recommend that mineral carriers of phosphoric acid be omitted from all soils, we do believe that our basal ration of 160 lbs. per acre is too high and that growers could well afford to test their land by leaving off phosphorus carriers from parts of their fields for a few years to see whether there is any deterioration in quality or yield. A saving of $10.00 an acre might be made with a little intelligent experimentation.

Potash. Four years test in the Poquonock experiments showed no loss from reduction of the potash to 150 pounds. No other experiments to determine the actual amount of potash required for Connecticut Valley tobacco soils are on record. In the absence of carefully conducted long continued experiments of this kind our recommendations are largely guesses. At present we are using 200 pounds of potash per acre.

Magnesia. Fifteen pounds of magnesia per acre has prevented the appearance of any symptoms of magnesia shortage. The large amounts of double manure salts used by some growers and put in some prepared mixtures, are excessive and useless if not actually injurious.

What Carriers are Best.

Since any one of the four tobacco nutrients may be obtained in a variety of different carriers, the grower who mixes his own fertilizer is next confronted with the necessity of deciding which ones he should use. His choice will be influenced partly by the relative cost and the supply and ease of mixing, but more partic-

ularly should he be guided by what experience and experiment have shown to be the effect of a given material on the quality and yield of tobacco. Apparently the tobacco plant responds differently to different carriers of the same nutrient. For instance, we know that tobacco grown with nitrate of soda as the only source of nitrogen is different from tobacco grown on cottonseed meal although there is no known difference in the nitrogen which is derived from the two. Concerning the effect of some of the carriers there is considerable knowledge but very few and insufficient tests have been made with others. Under the circumstances we believe that the grower will do well to use only those which long use has shown to be satisfactory and to avoid new or little tried materials until their worth has been demonstrated by unbiased and competent experimenters.

Ammonia. It is generally believed that a part of the ammonia should be derived from mineral sources but the larger part from organic sources. The mineral carriers are more active and are included usually as a starter. Also nitrogen from this source is less expensive. The recent station experiments indicate that mineral carriers may be used to furnish up to one-half the ammonia of the formula without injury to quality or yield. Some successful growers however, use no mineral carriers at all. Of the organic carriers, cottonseed meal is the most extensively used and regarded as standard. The grower can make no mistake in using this as his principal ammoniate. Castor pomace is used almost as extensively and it is questionable whether there is any difference in the effects of the two on quality of the tobacco. There is a general belief that it should be used more extensively on the lighter soils. Linseed meal seems to be about as good as either of the above, but experiments indicate that the yield is not quite as good. Dry ground fish is used in smaller quantities by most growers either in the original mixture or as a side dressing. There is an impression in some quarters that it is not best for the burn and aroma if too much is used. The same may be said of tankage. Of the mineral carriers of ammonia, nitrate of soda is standard. Sulfate of ammonia, which is sometimes used, is subject to the objection of adding too much sulfate to the soil. It could probably be used to advantage, however, where the soil has been made too nearly neutral and it is desired to make it more acid. Nitrate of potash should be an excellent source of mineral nitrogen if the supply was dependable. Ammonium phosphate ("Ammophos") should also be a good carrier since it carries two essential plant elements and the residue is small. It should be tried more extensively in an experimental way, however, before making sweeping recommendations. The same may also be said concerning synthetic urea and a whole list of other "air-nitrogen" materials.

Phosphoric acid. Precipitated bone is the standard. Acid

phosphate contains too much sulfate but the high grade treble superphosphate should be nearly free from this objection. Fish is a commonly used source of phosphoric acid. Ammophos as previously mentioned should be tested more extensively. In view of the previously mentioned low response of our tobacco soils to lack of this element, it is possible that raw rock phosphate, the cheapest of all sources of phosphorus, would furnish all that is necessary.

Potash. Carriers of potash have been fully discussed on a previous page. High grade sulfate is most extensively used but we believe that on the more acid soils carbonate in the pure form or in ashes could be substituted to advantage. Another very excellent source of potash is tobacco stems. In this source the grower not only gets potash but also phosphoric acid and nitrogen. Besides the four elements under discussion, it is possible that tobacco stems also furnish other things which are advantageous for the growth of tobacco but of which we have no specific knowledge. It is pretty safe to assume that whatever is needed by the tobacco plant will be found in "stems,"

In conclusion we believe that it is a good principle not to depend always on one carrier for each nutrient but to mix several carriers. On the same principle it is well to vary the formula from year to year.

STRAIN TESTS OF OUTDOOR TOBACCO.

P. J. Anderson and N. T. Nelson

It is a fact well known among tobacco growers and dealers that neither the Broadleaf nor the Havana tobacco grown in New England are all of the same strain. The differences in the Broadleaf are more pronounced and the different kinds have received distinctive names, such as the John Williams Broadleaf, Hockanum Broadleaf, etc. The distinctive features of some of these types are readily apparent even to the inexperienced, as for example, the long, pointed leaf shape of the Bantle Broadleaf. Some of the other types, however, are distinguished by characteristics which are apparent only to the eye of experts long accustomed to judging Broadleaf Tobacco. Even though the differences may not be apparent in the field, they may be quite plain on the sorting bench. A third way in which these differences are manifested is in the adaptability of certain strains to certain localities, for example, the John Williams strain in the South Windsor section. Nearly any experienced Broadleaf grower will tell you that *his* farm is better adapted to one particular type than to another.

The origin of these distinctive strains is not as clear as might be desired. In fact we know very little about the origin of Con-

necticut Broadleaf. Were these differences already there when the seed was originally brought to New England or have they developed since then? It is doubtful whether Connecticut Broadleaf had a common source. Undoubtedly different types were introduced at different times and the source is not recorded. For example, we are told that the John Williams Broadleaf was so called because a grower of that name living in Manchester obtained some seed from Washington, D. C. grew it and distributed seed to neighbors who liked the type he grew better than their own. Whether it was originally a Maryland Broadleaf, Pennsylvania, Ohio, or something else can only be guessed Other strains have been introduced in the same unrecorded way and are still being introduced, but nothing is put on record lest

FIG. 5.—Strain test plots on station farm. Broadleaf to left, Havana seed to right and Cuban Shade strains ahead.

the buyers should think it was not really Connecticut Broadleaf and would not pay so much.

It is entirely possible that differences have developed and become fixed in types of tobacco subsequent to their introduction here. Whether one believes that the differences in strains which he observes are due to small mutations or to segregation after fortuitous crossing is not of so much importance as the fact that these differences do exist and that they are inherited. Many growers have kept their own particular seed for twenty, thirty, or even forty years, always selecting the best plants for seed and as a result have won a reputation in their own-neighborhood for

growing a superior type. In some cases this reputation is probably not due to the seed but to the type of land on which the crop is grown; or, the cultural practices may be so judicious that it is difficult to distinguish the results of such differences in handling from those which are inherent in the strain. Progressive growers are constantly trying to improve their type of tobacco by selection of their seed plants or by getting better seed from some other source.

If such differences do exist it is reasonable to believe that some strains are better than others and will yield a larger profit to the grower when grown under similar conditions. The differences in which the grower and dealer are most interested are those which appear in the sorted tobacco. They should be measured by the sorting record and the expert's judgment of quality.

In order to see whether there are such differences it is necessary that the strains to be compared be grown on the same land side by side and with the same cultural treatment throughout and then sorted and judged together.

Such strain tests were started by the Tobacco Station in 1924 with the object of (1) determining definitely whether there are strain differences in the Broadleaf and Havana seed which will remain constant, (2) measuring such differences, if present, in terms of sorting and pooling, (3) picking the best strains for seed distribution, and (4) selecting strains for possible further improvement through individual plant selection. The seed lots for the original trials were selected by Mr. Hickey of the Connecticut Valley Tobacco Association. The lots were selected on the basis of the crop records of the growers rather than on any known differences. It seemed best to make the tests not only on the station farm but also on other farms to see whether the differences observed in one place would be the same elsewhere. Also it seemed essential in the case of the Broadleaf to grow each of the well recognized types in the section in which it was most extensively grown.

The tests have continued through only two years; results have been delayed through the unusually dry weather of the first year and in some cases by unfortunate selection of the fields for the tests. Nevertheless a preliminary report is offered at this time which should be considered only as a report of progress and not final.

Havana Seed Strain Tests.

*Tests of 1924.**

Some preliminary tests on a few strains of Havana seed were made at the Tobacco Station in 1922 and 1923. Although no

* Report by N. T. Nelson.

deailed records of yield and quality were kept, it was the opinion that the observed variability in type and quality of Connecticut tobaccos was more attributable to environmental differences than to the seed. In 1924 a larger number of seed lots was tested and sorting and pooling records taken. The tests were made both on the Tobacco Station farm and on the farm of Mr. Howard Henshaw in Suffield. The extremely dry summer in Windsor, however, resulted in a crop of such poor quality that records were taken only on the tobacco grown by Mr. Henshaw. Seed was furnished by the following growers:

W. K. Rice	Bloomfield
N. E. Kendall and Sons	Granby
Howard Henshaw	Suffield
L. C. Mills	Westminster
E. B. Graves	Canton
Lyman Crafts	Whateley
Larkin Proulx	Hatfield
Stanton Brown	Poquonock
M. Duda and Sons	Easthampton
L. J. Pelissier	Hadley
J. W. Alsop	Avon
Duncan Brothers	New Milford
George A. Peckham	Suffield
T. L. Warner	Sunderland
Howard Sikes	Suffield
F. A. Johnson	Southwick
J. E. Phelps	Suffield

The yield, sorting and pooling data are presented below in Table XII.

TABLE XII. HAVANA SEED STRAIN TESTS AT SUFFIELD, 1924. COMPARATIVE YIELDS, QUALITY AND RETURN PER ACRE.

Grower	Yield per acre	Price per pound	Total return per acre	Relative rating Yield	Relative rating Quality
Rice	1344	$0.2164	$280.71	69	51
Kendall	1764	0.3424	603.99	91	81
Henshaw	1596	0.4199	670.16	82	100
Mills	1596	0.3834	611.91	82	91
Graves	1428	0.3332	475.81	74	80
Crafts	1806	0.3904	704.06	93	93
Proulx	1596	0.3639	580.78	82	86
Brown	1932	0.4007	774.15	100	96
Duda	1596	0.3543	565.46	82	84
Pelissier	1764	0.3931	693.43	91	93
Alsop	1596	0.3218	513.59	82	70
Duncan	1764	0.3470	612.11	91	81
Peckham	1512	0.3420	517.10	78	81
Warner	1680	0.3054	513.07	87	73
Sikes	1596	0.2594	414.00	82	62
Johnson	1764	0.3708	654.09	91	88
Phelps	1386	0.2177	300.73	71	52

The price per pound is based on sorting percentages, pooling, and corresponding 1923 prices without deducting for sorting, packing and storage. The return per acre is the product of the yield and the price per pound. The yields ranged between 1344 and 1932 pounds per acre. Relative ratings were calculated by calling the best 100 and figuring the others on percentage of the best. Rating them in order of total return per acre, the relative rank of the first six is: Brown, Crafts, Pelissier, Henshaw, Johnson, and Duncan. The results of 1924, although preliminary, indicate good possibilities for improvement and selection on the average Havana now grown in the Valley.

Tests of 1925.

In 1925 the tests were conducted on a rather light sandy soil at the station farm. This field proved to be a rather unfortunate selection since there was apparently considerable leaching of the fertilizer just after the heavy rains of mid-season and the lower leaves turned yellow before harvesting. As a result the strains sorted out poorly. Nevertheless, this test has the advantage of showing what the different strains will do under adverse conditions. The tobacco was sorted and pooled as described under the fertilizer tests. The pool rating, acre yield, price per pound and return per acre are presented in Table XIII.

TABLE XIII. HAVANA STRAINS AT TOBACCO STATION—1925. POOL RATING, ACRE YIELD, PRICE PER POUND, AND NET RETURN.

Strain	Rating	Acre yield	Average price	Total Value	Sorting and Overhead	Net Value
Shean	C	1385	$0.2609	$361.35	$106.16	$255.19
Crafts	D	1410	0.2735	385.42	111.67	273.75
Proulx	C	1276	0.2298	293.22	90.21	203.01
Brown	D	1367	0.2317	316.67	100.13	216.54
Pelissier	C	1147	0.2022	231.87	72.33	159.54
Viets	D	1250	0.2273	284.13	87.31	196.82
Warner	D	1244	0.2312	287.55	76.69	210.86
Duncan	C	1311	0.3021	396.05	81.90	314.15
Johnson	C	1194	0.2371	283.04	72.06	210.98
Alsop	D	1209	0.1763	213.15	62.75	150.40
Graves	D	1214	0.2112	256.40	74.05	182.35
Henshaw	C	1240	0.2121	262.94	72.42	190.52
Peckham	D	1396	0.2803	391.23	96.04	295.19
Kendall	C	1218	0.2716	330.81	80.63	250.18

Using total return per acre as basis of rating, as for the 1924 series, the first six are: Duncan, Peckham, Crafts, Shean, Kendall, Brown. Three of the first six were the same for both years, viz., Brown, Crafts, and Duncan.

Final conclusions as to the relative value of the strains, however, must wait until after more comprehensive tests of longer duration.

Broadleaf Strain Tests.

*Tests of 1924.**

Very little work was done on Broadleaf during 1922 and 1923. In 1924 the Broadleaf project was expanded through the coöperation of the Connecticut Valley Tobacco Association and the Hartford County Farm Bureau. Several lots of seeds representing each of the leading types of Connecticut Broadleaf were secured and tested in their respective districts. The results of these tests are given in Table XIV. The only fair comparisons are between the different strains of one type. The different types cannot be compared for they were grown on different farms.

Table XIV. Comparative Yields, Quality and Return Per Acre on Broadleaf Lots in Farmer's Coöperative Trials—1924.

Type	Strain	Yield per acre Lb.	Price per pound $	Return per acre $	Relative rating Yield %	Relative rating Quality %
John Williams Broadleaf at H. Vibert's So. Windsor	Cannon	1834	.3995	732.68	91	73
	Hambach	1799	.4378	789.60	90	79
	Cavanaugh	1785	.3863	789.55	89	70
	Foran Bros.	1890	.5062	956.72	94	92
	Vibert	1750	.4420	773.50	87	81
	Killam	1659	.3933	652.48	83	72
	Riordan	1715	.4011	687.89	86	73
	Bancroft	1554	.5488	737.84	78	100
	Miskill	2009	.4748	953.87	100	86
	Grant	1895	.4183	792.68	96	76
Frank Roberts Broadleaf at F. H. Ensign's Silver Lane	Roberts	1960	.2493	488.63	100	74
	Hills	1925	.2782	535.54	98	83
	Oliver	1645	.1338	220.10	74	39
	Heller	1610	.2785	448.39	72	83
	McIlvane	1610	.2097	337.62	72	62
	Ensign	1855	.2185	405.32	95	65
	Vogel	1680	.1292	212.06	76	38
	Forbes	1890	.3367	636.36	96	100
	Evans	1680	.2065	346.92	76	61
Hockanum Broadleaf at J. M. Herr Hockanum	Geiselman	1715	.0871	149.38	99	34
	Cooley	1722	.2516	433.26	100	99
	Hamilton	1575	.1685	265.39	92	66
	Dusch	1440	.1325	194.78	84	52
	Brewer	1484	.2309	342.66	86	91
	Hollister	1624	.2232	352.48	94	87
	Dunham	1610	.2543	409.42	93	100
	Horton	1659	.2349	389.70	96	92
	Herr	1715	.2432	417.09	99	96
Barber Broadleaf at Burnham Liebler's So. Glastonbury	Demar	1952	.1483	289.63	100	93
	H. Smith	1922	.1073	206.23	98	67
	Liebler	1798	.1372	245.69	92	86
	Bachl	1488	.1032	153.56	75	65
	G. Smith	1643	.1434	235.61	84	89
	Hoffman	1829	.1598	292.27	93	100

* Report by N. T. Nelson.

An examination of Table XIV shows the wide variation within each type, some strains returning twice the value per acre of others. How much of this was due to inherent strain differences, how much to soil variation or to other sources of error cannot be stated. The tests of 1924 indicated the need for a continuation of this work as reported below.

John Williams Broadleaf Tests of 1925.

The John Williams strain trials were conducted on the farms of Mr. Horace Vibert of South Windsor, Mr. E. Handel of Glastonbury and at the Tobacco Station. This type did not do well as Handel's although other types alongside it on the same field of apparently quite uniform soil did very well. Mr. Handel, in former years, had tried the John Williams tobacco on his farm but had discarded it for the Hockanum type because the John Williams was unsatisfactory there. The growth was only fair at the Station Farm but was quite satisfactory in South Windsor where this type is generally recognized as being at its best. For this reason more weight should be attached to these tests in that locality than at the other two. All tests were on single rows of 100 plants each.

The percentage of grades is presented in Table XV and the rating, acre yield, average price per pound, and net return in Table XVI.

TABLE XV. JOHN WILLIAMS STRAINS OF BROADLEAF. PERCENTAGE OF GRADES, 1925.

(T = Tobacco Station, V = Vibert, H = Handel)

Strain	L. W.			M. W.			Long Sec.			Sh. Sec.			Long Dks.			Dk. Stem.			No. 2 Sec.			Brk. and Filr.		
	T	V	H	T	V	H	T	V	H	T	V	H	T	V	H	T	V	H	T	V	H	T	V	H
Cannon	6	1		4	3		15	32		1	8		20	22		27	13		10	10		17	11	
Hambach	4	0	5	2	5	3	17	24	22	1	8	3	19	25	25	24	8	15	7	19	12	26	11	15
Cavanaugh	2			1			13			0			19			28			17			20		
Vibert	2	2	0	3	3	0	19	18	20	2	4	3	23	25	27	20	22	18	15	15	6	16	11	26
Riordan	5	5	10	3	7	10	18	26	24	1	8	3	20	21	25	18	11	11	14	11	5	21	11	12
Bancroft	4	4	0	2	8	0	15	27	20	0	3	2	20	22	17	22	11	16	14	16	17	23	9	28
Miskill	6	0	2	6	4	1	18	18	25	1	5	1	21	24	24	21	21	14	12	17	18	15	11	15
Grant	3			4			19			1			16			22			13			22		

TABLE XVI. JOHN WILLIAMS BROADLEAF STRAIN TESTS, 1925 POOL RATING, ACRE YIELD, AVERAGE PRICE, AND NET RETURNS.

Strain	Rating	Acre Yield	Av. Price per lb.	Tot. Value per Acre	Sorting and Overhead	Net Return
			Vibert Farm, South Windsor.			
Cannon	B	2164	$0.37145	$803.82	$182.64	$621.18
Hambach	B	2010	0.3604	724.40	176.28	548.12
Vibert	C	1991	0.2866	570.62	156.40	414.22
Riordan	C	1984	0.35335	701.05	170.03	531.02
Bancroft	B	2063	0.38975	804.05	179.58	624.47
Miskill	C	2317	0.28405	658.14	183.51	474.63
			Handel Farm, Glastonbury.			
Hambach	B	1126	$0.34225	$385.37	$ 90.66	$294.70
Vibert	A	1008	0.3041	306.53	70.94	235.59
Riordan	B	1230	0.40515	498.33	105.61	392.72
Bancroft	C	1025	0.2543	260.66	73.19	187.47
Miskill	B	1156	0.332	383.79	93.81	289.98
			Tobacco Station Farm.			
Cannon	B	1338	$0.30075	$402.40	$ 95.04	$306.36
Hambach	A	1352	0.314	424.53	91.26	333.27
Cavanaugh ...	C	1156	0.2397	277.09	79.53	197.56
Vibert	B	1053	0.3073	323.59	80.66	242.93
Riordan	C	1270	0.2857	362.84	94.81	268.03
Bancroft	A	1140	0.35(?)	399.00	80.66	318.34
Miskill	A	1327	0.38165	506.45	101.64	404.81
Grant	C	1206	0.2752	331.89	86.11	245.78

The Foran strain which made a good record in 1924 was not planted on account of lack of seed. The Cavanaugh strain was found to be the same seed as the Vibert strain and hence was not tested at Vibert's or Handel's. The seed of the Grant and Cannon strains did not come well in the seed beds and hence there was a shortage of plants, which accounts for the fact that they were not set at all three farms. In point of yield alone, the Miskill strain has made much the best showing. It was highest in the 1924 test, highest at Vibert's in 1925, second at Handel's and within 25 lbs. of the highest at the station farm. It was within $3.00 per acre of the highest in net return in 1924, highest in net return at the station farm in 1925. The net return at Vibert's, however, was much less than some of the others because of the high percentage of dark grades. In point of quality the Bancroft strain has made an excellent showing being rated as best in 1924, best at Vibert's, second at the Station Farm, but poorest at Handel's.

Frank Roberts Broadleaf Strains in 1925.

These tests were on the farms of Mr. Howard Ensign at Silver Lane, at the Station Farm, and at Handel's. Growth was best at Ensign's where the tests of 1924 were also conducted.

TABLE XVII. PERCENTAGE OF GRADES IN THE FRANK ROBERTS BROADLEAF STRAIN TESTS OF 1925.

(T = Tobacco Station, E = Ensign, H = Handel)

Strain	L. W.			M. W.			Lg. Sec.			Short Sec.			Long Dk.			Dk. Stem.			No. 2 Sec.			Brk. and Flr.		
	T	E	H	T	E	H	T	E	H	T	E	H	T	E	H	T	E	H	T	E	H	T	E	H
Roberts	2	4	9	1	6	16	14	25	23	1	1	2	16	30	26	25	12	7	13	7	8	28	15	9
Hills	0	1	5	0	4	8	9	23	21	0	2	3	11	28	29	37	17	10	15	7	11	28	16	12
Heller	0	3	6	0	3	8	8	19	22	0	1	2	12	28	31	29	25	9	14	8	14	37	15	9
McIlvane	0	4	5	0	5	11	10	24	29	0	1	1	10	26	27	31	20	9	14	5	10	35	15	8
Ensign	3	6	4	1	10	8	10	26	20	1	2	1	16	32	28	31	8	15	15	4	14	23	12	10
Vogel	0	1	7	0	2	11	12	25	29	0	1	2	19	25	29	28	22	9	18	9	6	23	15	7
Forbes	0	6	2	0	4	4	9	22	22	0	1	2	12	28	24	34	19	16	11	6	10	34	14	20
Evans	0	2	4	0	2	9	10	27	23	1	2	3	13	30	27	33	17	12	17	8	10	26	12	12

The Station tobacco of this strain sorted out very poorly and the results cannot be considered as indicative as the others, particularly at Ensign's.

The final data on these tests are presented in Tables XVII and XVIII.

TABLE XVIII. FRANK ROBERTS BROADLEAF STRAIN TESTS, 1925. POOL RATING, ACRE YIELD, AVERAGE PRICE PER POUND AND NET RETURN.

Strain	Rating	Acre Yield	Av. Price per lb.	Tot. Value per Acre	Sorting and Overhead	Net Return
			Handel Farm.			
Roberts	B	1381	$0.42835	$591.55	$122.74	$468.81
Hills	C	1230	0.3401	418.32	105.41	312.91
Heller	C	1331	0.34515	459.39	117.53	341.86
McIlvane	C	1390	0.37365	519.37	123.64	395.73
Ensign	C	1181	0.32385	382.47	103.34	279.13
Vogel	C	1348	0.38335	516.76	120.78	395.96
Forbes	C	1196	0.2906	347.56	91.61	255.95
Evans	D	1268	0.3084	391.05	107.02	284.03
			Ensign Farm.			
Roberts	B	1626	$0.3545	$576.42	$134.06	$442.36
Hills	B	1494	0.32815	490.26	117.35	372.91
Heller	B	1747	0.28945	505.67	129.28	376.39
McIlvane	B	1560	0.3341	521.20	107.38	413.82
Ensign	B	1698	0.3928	666.97	147.73	519.24
Vogel	B	1647	0.3150	518.80	125.09	393.71
Forbes	B	1682	0.33885	569.95	132.12	437.83
Evans.........	B	1693	0.33735	571.13	137.39	433.74
			Tobacco Station Farm.			
Roberts	D	1219	$0.21615	$263.49	$80.91	$182.58
Hills	C	1110	0.18975	210.62	64.10	146.52
Heller	D	1190	0.17185	204.50	67.95	136.55
McIlvane	D	1103	0.17755	195.84	63.08	132.76
Ensign	C	1230	0.22645	278.53	79.83	198.70
Vogel	D	1231	0.2053	252.72	82.42	170.30
Forbes	D	1143	0.1721	196.71	63.78	132.93
Evans	D	1095	0.18975	207.78	67.61	140.17

Hockanum Broadleaf Strain Tests of 1925.

The best test of the strains of the Hockanum type was at the Handel farm in Glastonbury where the Hockanum is said to grow at its best and where, on the Handel farm, it was very plainly better than the other types. Growth at the Station Farm was not as good as for the John Williams type. Sorting and pooling data are presented in Tables XIX and XX.

TABLE XIX. HOCKANUM BROADLEAF TESTS, 1925. PERCENTAGE OF GRADES.
(T = Tobacco Station. H = Handel Farm.)

Strain	L. W.		M. W.		Long Sec.		Short Sec.		Long Darks		Dark Stem.		No. 2 Sec.		Brk. and Flr.	
	T	H	T	H	T	H	T	H	T	H	T	H	T	H	T	H
Cooley	0	22	0	28	8	17	0	2	18	22	23	0	18	4	33	5
Hamilton ...	0	10	0	16	9	22	0	2	13	24	38	12	18	7	22	7
Dunham	0	21	0	30	7	16	0	1	12	20	23	2	14	4	44	6
Horton	0	12	0	23	6	20	0	1	8	27	32	6	14	6	40	5
Herr	0	20	0	19	6	26	0	1	8	19	25	4	14	3	47	8
Geiselman ...	0	14	0	18	5	22	0	1	12	26	32	4	19	10	32	5
Hollister	4	9	0	14	15	27	1	2	12	24	24	10	13	7	31	7
Dusch	4	10	0	10	12	31	0	1	16	26	28	7	19	7	21	8

TABLE XX. HOCKANUM BROADLEAF STRAIN TESTS, 1925. POOL RATING, ACRE YIELD, PRICE PER POUND, AND NET RETURN.

Handel Farm.

Strain	Rating	Acre Yield	Av. Price per lb.	Tot. Value per Acre	Sorting and Overhead	Net Return
Cooley	A	1612	$0.6315	$1,017.98	$155.96	$862.02
Hamilton	B	1590	0.4255	676.55	139.36	537.19
Dunham	B	1485	0.58 ?	861.30	140.78	720.52
Horton	B	1832	0.4631	848.40	170.10	678.30
Herr	B	1544	0.5077	883.89	142.36	741.53
Geiselman	B	1711	0.4697	803.66	161.09	642.57
Hollister	B	1323	0.4332	573.12	117.68	455.44
Dusch	B	1354	0.43965	595.29	122.17	473.12
			Tobacco Station Farm.			
Cooley	D	1242	$0.18615	$231.20	$78.99	$152.21
Hamilton	C	1191	0.1995	237.60	72.65	164.95
Dunham	D	1203	0.16625	200.00	67.91	132.09
Horton	D	1275	0.1584	201.96	67.83	134.13
Herr	C	1349	0.16605	224.00	71.77	152.23
Geiselman	C	1162	0.1801	209.28	67.86	141.42
Hollister	D	1156	0.2201	254.44	74.27	180.17
Dusch	C	1290	0.2421	312.31	87.91	224.40

Among the strains of this type are two which stand out as preëminently the best, viz., the Cooley and the Dunham strain. After the completion of the 1925 tests it was learned that these two strains have a common origin in the same lot of seed within recent years.

Bantle Broadleaf Strain Tests of 1925.

These tests were also conducted at the Tobacco Station and at the Handel Farm in Glastonbury. Sorting and pooling data are presented in Tables XXI and XXII.

TABLE XXI. PERCENTAGE OF GRADES IN BANTLE BROADLEAF, 1925.
(T = Tobacco Station. H = Handel)

Strain	L. W.		M. W.		Long Sec.		Short Sec.		Long Dark		Dark Stem.		No. 2 Sec.		Brk. and Flr.	
	T	H	T	H	T	H	T	H	T	H	T	H	T	H	T	H
Bidwell	1	7	0	8	8	28	0	2	25	26	21	11	21	8	24	10
Lorenze	2	7	1	9	14	29	1	2	27	31	19	10	21	7	15	5
Bantley	3	15	3	19	17	22	1	2	27	29	19	4	13	3	17	6
Fox	0	14	1	19	14	24	1	1	24	21	22	10	20	4	18	7
Benton	3	13	2	17	19	24	0	1	19	24	24	8	13	6	20	7
Bantle	4	7	1	13	16	29	0	1	23	24	22	9	16	9	18	8
Hickey	2	23	0	18	15	17	1	1	21	24	25	8	15	2	19	7
Estrom	1	10	0	11	12	29	0	1	18	28	24	7	19	8	26	6

TABLE XXII. BANTLE BROADLEAF STRAIN TESTS, 1925. POOL RATING, ACRE YIELD, PRICE PER POUND, AND NET RETURN.

Handel Farm.

Strain	Rating	Acre Yield	Av. Price per lb.	Tot. Value per Acre	Sorting and Overhead	Net Return
Bidwell	B	1244	$0.39985	$497.41	$107.42	$389.99
Lorenze	B	1260	0.4163	524.54	113.72	410.82
Bantley	C	1454	0.4292	624.06	135.95	488.11
Fox	C	1415	0.4204	594.87	126.51	468.36
Benton	B	1412	0.4551	642.60	127.43	515.17
Bantle	B	1352	0.42535	575.07	120.26	454.81
Hickey	C	1263	0.4386	553.95	113.99	439.96
Estrom	B	1490	0.44065	656.57	136.41	520.16

Tobacco Station Farm.

Strain	Rating	Acre Yield	Av. Price per lb.	Tot. Value per Acre	Sorting and Overhead	Net Return
Bidwell	D	1140	$0.20635	$235.24	$ 81.66	$153.58
Lorenze	C	1152	0.26595	306.37	89.74	216.63
Bantley	B	1395	0.30265	422.20	106.86	315.34
Fox	C	1163	0.2476	287.96	86.06	201.90
Benton	C	1157	0.2686	310.77	82.61	228.16
Bantle	C	1183	0.2685	317.64	87.54	230.10
Hickey	C	1318	0.25445	335.36	94.10	241.26
Estrom	D	1209	0.2096	253.41	81.61	171.80

Barber Broadleaf Strain Tests of 1925.

These tests were conducted at the same places as the Bantle and Hockanum. Results are presented in Tables XXIII and XXIV.

TABLE XXIII. BARBER BROADLEAF STRAINS, 1925. PERCENTAGE OF GRADES.
(T = Tobacco Station. H = Handel.)

Strain	L. W.		M. W.		Long Sec.		Short Sec.		Long Darks		Dark Stem.		No. 2 Sec.		Brk and Flr.	
	T	H	T	H	T	H	T	H	T	H	T	H	T	H	T	H
Liebler	3	8	1	15	15	21	0	1	21	32	20	6	14	9	26	8
Bachl	0	8	0	16	8	29	0	2	13	24	27	8	14	4	38	9
G. Smith	2	18	0	18	11	21	0	2	18	19	29	11	19	5	21	6
Hoffman	0	13	0	19	7	24	0	2	17	27	25	6	14	5	37	4

TABLE XXIV. BARBER BROADLEAF STRAIN TESTS, 1925. POOL RATING, ACRE YIELD, PRICE PER POUND, AND NET RETURN.

Strain	Rating	Acre Yield	Av. Price per lb.	Tot. Value per Acre	Sorting and Overhead	Net Return
Handel Farm.						
Liebler	C	1444	$0.3787	$546.84	$131.27	$415.57
Bachl	B	1590	0.4385	697.22	141.43	555.79
G. Smith	A	1882	0.55805	1,050.25	167.40	882.85
Hoffman	B	1652	0.4712	778.42	154.46	623.96
Tobacco Station Farm.						
Liebler	D	1296	$0.2312	$299.64	$90.85	$208.79
Bachl	C	1254	0.18375	230.42	72.52	157.90
G. Smith	D	1319	0.21185	279.43	89.03	190.40
Hoffman	D	1300	0.17425	226.53	77.61	148.92

IMPROVEMENT OF SHADE TOBACCO BY HYBRIDIZATION AND SELECTION.

D. F. Jones, P. J. Anderson and N. T. Nelson.

The testing of Cuban strains and hybrids which has been in progress under the direction of D. F. Jones in charge of Plant Breeding since the establishment of the Tobacco Station, has been continued during the season of 1925. Sixty-three strains were grown under cloth, including selections by Beinhart and Chapman, selections from a strain grown by Clark Bros. of Windsor, selections from imported Partidos and Vuelta Abajo seed, Big Cuban, resistant Cuban and various hybrids originated by Jones. As a check with which to compare these, every fourth row in the tent was set with plants from seed of a good local strain furnished by Mr. J. B. Stewart of Windsor. This is the strain which Mr. Stewart originally selected from imported Cuban seed and which he developed while in the employ of the United States Department of Agriculture and has carefully guarded by constant selection during the last twenty years. Each row was harvested separately. After bulk sweating in the usual way, all strains were sorted by an experienced sorter and complete records made on percentage of all grades and general notes on quality, burn, etc. Sample hands from the best three grades (L, LL, LV) were kept out and have been submitted to experienced judges of shade tobacco for their opinion. Since neither the sorting records and notes nor the opinion of the experts indicates that any of these strains is superior to the Stewart strain, there seems to be no object in publishing here the rather lengthy sorting records of these tests. These records are tabulated and filed at the Tobacco Station where they may be consulted by any growers or others who may be interested in them.

When the Cuban variety of tobacco now commonly grown in the Connecticut Valley was first grown under shade cloth here, it was found that it lacked the uniformity which the manufacturer desires and which is necessary to make the raising of this most expensive type profitable. There were too many plants which either yielded no leaves of the high grades or so few that there was no profit. The variety was made uniform or standardized by several years of selection and breeding from plants with a high record for production of better grades. Yet there are few shade growers who are satisfied that the strain they are growing is either as uniform or as good as they would like. Any shade grower can point out in his fields several types of plants. How many of these are genetic differences which will breed true? If they do breed true, which type will produce the highest percentage of good grades? Are some of these types inferior and responsible for a high percentage of the low grades which we would like to keep out of the sorting shop? These questions can be answered only by keeping separate records of the leaves from individual plants through the sorting, saving the seed of each one and keeping year after year the sorting records of the progeny. This involves a considerable amount of tedious work which very few growers care to undertake, especially since it comes in the very busiest season when they have little time to think of anything except getting the crop harvested.

Believing that there is a possibility for the improvement of the Cuban variety through this method of selection the writers began by keeping individual records on 1000 plants of the Stewart strain in 1925. Each priming of each plant was labelled permanently so that when the cured and fermented leaves came to the sorting bench it was possible to tell the plant from which every leaf came. After taking the sorting and sizing record of every leaf of the thousand plants, all the leaves from each plant were assembled and the product of each one of the 1000 appraised as a whole. The most promising of these individual plant selections will be grown and compared on the basis of their progeny performance record. Additional selections will be made within certain lines to test their uniformity and fixity of type.

The points for which we are selecting and which we hope to attain by this method are:

1. Larger number of L's per plant
2. Thinner leaves
3. Better shape
4. Better burn
5. Less prominent vein
6. Those other characteristics of the leaf which we group under the undefinable term "quality" but which are hard to separate and enumerate but are very evident to every experienced tobacco man.

Wide variations were found in the product of different plants. Contrasted with some plants which did not bear a single L were others with 10 L's. Some had thin leaves almost up to the top of the plant, others were thick throughout. The plants with thin leaves at the bottom suddenly becoming thick at about the 12th leaf predominated. Whether the exceptions are due to inherent differences in the seed or to place effect is the question on which the possibility of improvement by this method hinges. Not only were the best plants selected for further progeny test, but also some of the poorest plants. It was also found that quality in the cured product was correlated with certain observable differences in the field.

COVER CROPS FOR TOBACCO

P. J. Anderson.

It was stated in the introduction that there are no results as yet on the cover crop project since this was not started until the fall of 1925. However the cover crop problem is one which is the subject of considerable discussion at present, not only in the tobacco sections of New England but also in other parts of the country, and a brief statement of what the problem is and its present status seems worth while.

When the present generation of tobacco growers were boys, the planting of a winter crop on the fields was unknown. The fields were left bare from the time the crop was harvested until the next crop was set in June. With the beginning of the present century, however, there was a widespread movement, fostered largely by agricultural experts, for seeding the land each fall to some crop to keep the ground covered through the winter and spring. Within a few years this practice became quite general until it is safe to estimate that now more than half the tobacco land is seeded every fall. Probably ninety per cent of the crop is timothy, five per cent rye and the rest more unusual crops such as winter vetch, barley, oats, etc. The leguminous crops, other than vetch, have been used very little, probably because experience has shown that they do not winter well or they do not thrive on the acid tobacco land.*

A puzzling feature about this wholesale adoption of the cover crop practice is the entire absence of any published experimental data to show that the succeeding crop of tobacco derives any benefit from it. At least three reasons have been assigned for the use of these crops on tobacco land:

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* The fact that some of them are known to be hosts of the black rootrot fungus has also had its influence against them.

(1) On light lands it prevents the land from blowing. This is probably correct to a large extent but it gives no reason for the use of a cover crop on some thousands of acres of land which rarely, if ever, blows.

(2) It holds nitrogen which would otherwise leach away and furnishes it to the next crop of tobacco. It unquestionably does take up nitrogen but whether this nitrogen is used to advantage by the succeeding tobacco crop is open to question.

(3) The reason most frequently given for the cover crop is that it adds a large amount of humus to the soil. It is doubtful whether many growers would take the trouble to put in cover crops except on some light "sand blows" if it were not for this last supposed benefit. This third reason is based on the assumption that the addition of organic matter is always *per se* a direct benefit to soil.

One also frequently hears it said by farmers that a cover crop adds nitrogen or other fertilizer elements to the soil. It is probably superfluous to point out that the cover crop returns to the soil only such fertilizer elements as it took from the soil in the first place and adds nothing to them, unless it be a leguminous crop such as vetch in which case it may add some nitrogen. The main element which it *adds* to the soil is *carbon* (derived from the air), concerning which we shall speak below.

Five years ago the writer had occasion, in connection with some black rootrot experiments in Massachusetts, to compare the effect of timothy cover crop and no cover crop on alternating one-quarter acre strips of land. This experiment was not planned to test the value of timothy as a cover crop but rather the effect of the timothy cover crop on black rootrot. It was assumed at the outset that the timothy would increase the yield or improve the quality of the tobacco—or both. When, however, the harvesting records of the plots were computed and compared it was a surprise to find that the most outstanding result of the whole experiment was the fact that the timothy had *reduced* the yield of tobacco. The experiment was continued for the two following years on the same plots and each year the depressed yield was observable in the field and measurable on the sorting bench. In a later, more comprehensive experiment on a different field at the Massachusetts Agricultural Experiment Station, J. P. Jones found that ten plots without timothy cover crops yielded an average of 165 pounds per acre more than ten adjacent plots with cover crops and that the quality was in about the same ratio.*

* Jones, J. P. Havana seed Tobacco as Influenced by Timothy Cover Crop. Mass. Agric. Expt. Sta. Circ. 73. 1925.

Such, in summary, is the experimental data on which our present estimation of the value of the timothy cover crop is based. In the absence of any conflicting data of scientific experimental calibre, the conclusion seems warranted that timothy not only does not benefit tobacco but is on the contrary detrimental, at least under the conditions of these trials.

In what way could the cover crop produce an injurious effect on the tobacco crop? The cover crop idea has been adopted with entire disregard of two fairly well known agricultural facts:

1. Certain crops do have an injurious effect on the succeeding crops.
2. Organic matter added to the soil is not always beneficial, but may be absolutely harmful.

Space is lacking to review the literature on these points but a brief statement on each may be worth while:

Influence of one crop on another. Almost a hundred years ago, DeCandolle began to experiment and theorize on the toxic influence of one crop on another showing that it was then recognized. Various other investigators, too numerous to mention here, have worked and theorized on the same peculiarity. Very conveniently, within the last year, there has been published a very comprehensive review of the literature of this subject and the theories as to the cause,* and the reader is referred to this publication, for further information. The principal theories advanced have been (1) the soil toxin theory, (2) the fertilizer exhaustion theory, (3) the plant pathogen theory. Although these experimenters do not decide which of these theories is responsible, their experimental work does show "that the tobacco plant is particularly sensitive to the effects of preceding crops and attempts to apply intensive methods, as turning under soil improvement crop freely . . . . are likely to fail. The growth of the tobacco plant may be seriously retarded as a result of the effects of preceding crops of tobacco itself or of various other plants." Although their results were not always consistent, they were not able to find that any of the cover or rotation crops could be depended on to improve the tobacco and that usually they were positively injurious. They found that the harmful factor was the roots of the preceding crops rather than the tops. This is rather significant to the farmers of the Connecticut Valley in view of the fact that the use of timothy as a cover crop has been urged because of the organic matter furnished by its unusually large root development.

But our tobacco farmers do not need such far away exper-

* Garner, W. W., W. M. Lunn, and D. E. Brown. Effects of crops on the yields of succeeding crops in the rotation, with special reference to tobacco. Jour. Agric. Res. 30: 1095-1132. 1925.

imental evidence to prove the sensitiveness of tobacco to a preceding crop. It is pretty general knowledge among growers that tobacco does not do well on a grass sod of the previous year. Neither the yield nor the quality is good under these conditions and most of the growers admit that they do not expect good tobacco the first year.* Yet by some obscure mental hocus pocus these same growers believe that the same grass crop when used as a cover crop will have a different effect from what it would if used as a rotation crop. If there is such a difference, its effect would probably aggravate rather than alleviate the ill effect of a grass crop.

Vegetable organic matter not always beneficial. It is a more recently established fact that the addition of plant materials with a high carbohydrate content such as straw, green manure, sawdust, etc., to the soil may materially depress the growth of following crops. It is therefore not at all safe for the grower to assume that he is improving his land by turning green manure crops into it. The experimental evidence on this problem has recently been reviewed by Collison and Conn† and new light shed on it by their experiments with straw. They find that plant residues incorporated in the soil have a harmful influence in two ways; (1) by giving rise to a toxic substance which acts deleteriously on the roots of the plants, and (2) by stimulating (by means of their carbonaceous energy-forming material) the growth in the soil of a class of organisms which require more nitrogen than the decomposing straw or plant residue can furnish and thus they deplete the soil of nitrates. If these principles hold true for the timothy cover crop on tobacco soils, then we may expect that the timothy not only does not furnish nitrogen to the tobacco plants, but that it produces effects which actually rob the plant of the nitrogen which is put into the soil in the fertilizer. They, and others, have found that the deleterious effect would be partially, at least, overcome by supplying sufficient nitrate in readily available form to supply both the plants and the denitrifying organisms. Thus the grower who uses a cover crop should add more nitrogen in his fertilizer than the one who uses no cover crop. If however, these plant residues have had a long time to rot, the effect gradually disappears; thus the growers previously mentioned, who find that they get better results by plowing under a grass sod in the fall and adding heavy applications of manure, are escaping the injurious effects of a cover crop plowed under immediately before setting the crop. In some experiments at

* Heavy applications of manure and fall plowing of grass sod have been found by some to overcome this, at least partially. The reason is explained below.

†Collison, R. C. and Conn, H. J. The effects of straw on plant growth. N. Y. (Geneva) Agric. Expt. Sta. Res. Bul. 114. 1925.

the Tobacco Station in 1925 it was noted on plots where some of the cover crop was plowed under on April 1 and the rest six weeks later that there was a remarkable difference in favor of the early plowed when no fertilizer was added. But on plots which were heavily fertilized the difference was not so noticeable. If the grower is going to use cover crops he will do well to plow them under early and give them abundant opportunity to rot before the tobacco is set.

In the Massachusetts experiments previously mentioned the writer found, on examining the roots of the tobacco, that those on the timothy plots were more seriously affected with brown rootrot. This is also confirmed by considerable observational field evidence showing that the timothy, whether in rotation or as a cover crop, "predisposes" the following tobacco crop to brown rootrot. Since however, we know nothing about the cause of brown rootrot it is hardly an illuminating explanation of the effect of timothy on tobacco, to say that is produces brown rootrot. Brown rootrot may be merely the expression on tobacco roots of the toxic effect of a preceding crop comparable to the effects of plant residues described by Collison and Conn on other plants.

This brief review shows how far we are from a solution of the cover crop problem. It was in an attempt to learn more about it that the cover crops plots were started at the Station in 1925.

BLACK ROOTROT AND SOIL REACTION.

P. J. Anderson and M. F. Morgan.

In 1908 Briggs* first called attention to the fact that the application of lime, wood ashes, alkaline fertilizers, or other substances which tend to make the soil alkaline, favor the development of black rootrot and that this disease, which had become very serious in the Connecticut Valley at that time, could be kept in check by avoiding such substances. He apparently did not measure the actual degree of acidity in the soils under experiment. Johnson and Hartman† in Wisconsin, and Chapman‡ in Massachusetts confirmed the general conclusion of Briggs that rootrot is favored by the application of substances which reduce the acidity of the soil. The former by plot experiments and the latter by field survey attempted to measure in terms of lime requirement the degree of acidity which is necessary to prevent damage

*Briggs, L. J. The field treatment of tobacco rootrot. U. S. Dept. Agr. Bureau Plant Industry, Cir. 7, 1908.

†Johnson, J. J. and Hartman, R. E. Influence of soil environment on the rootrot of tobacco. Jour. Agr. Res. 17:41-86, 1919.

‡Chapman, G. H. Tobacco investigations. Mass. Agr. Exp. Sta. Bul. 195. 1920.

from rootrot. Johnson and Hartman found the disease practically absent in soil with a lime requirement of 9.38 tons, considerable infection at 7.19 tons and heavy infection at 4.6 and all more alkaline soils. Chapman found heavy infection usually present in soils with a lime requirement of 3000 to 8000 pounds. but very little in soils either more acid than the 8000 pound requirement or less acid than the 3000 pound requirement. The latter finding is not in agreement with the Wisconsin results.

It has been mentioned previously in this report that most growers, constantly warned against the danger of using lime, wood ashes or carbonate of potash, have ceased altogether to use them. On the other hand there is good evidence both from experience of growers and scientific experiment that a moderate amount of all three of these substances is beneficial for tobacco. Many have decided that they have gone too far in the omission of alkaline substances and are returning to the practice of liming or using wood ashes. In some cases this has been attended with favorable results. In other cases the results have been disastrous in bringing on rootrot and rendering the land unfit for tobacco. More puzzling to the grower is the fact that the same application of lime on two fields may benefit one and ruin the other.

In the face of the fact that some soils apparently need these substances and others do not, how shall the grower know what practice to follow? Is there not some simple soil tests by which we may quickly determine what treatment a field should receive? It was in an attempt to answer this question, to find such a test, that the writers began the investigation now to be discussed. This investigation has been in progress only one year and is far from complete, but it seems advisable to make yearly reports of progress because we believe that the results already secured will be of benefit to the growers and because it is hoped that they will be in better position to coöperate with us in this work if they understand from the annual reports the purpose and progress of the investigation.

It is obvious from the work previously mentioned that lime, wood ashes and carbonate of potash do not directly affect the organism causing rootrot by furnishing elements of food or through a direct stimulating effect, but they merely reduce the acidity of the soil which would otherwise be detrimental to its growth or ability to attack the tobacco roots. In other words, damage from infection can occur only when the roots of the plant are in a soil the acidity of which has been reduced beyond a certain critical point. Just where is that critical point? To answer this question was the first and most important task of the investigation. First of all, the answer should be sought through a wide soil survey. It is planned to take and test for degree of acidity, soil samples from at least 1000 tobacco fields scattered throughout the Connecticut and the Housatohic Valleys, making

a record in each case of the presence or absence of rootrot on each field and the severity of infection if present. With this information before us we should be able to determine what correlation exists between rootrot and soil reaction. Incidentally it is also hoped that we may learn whether there is an optimum reaction for the growth of tobacco and where that optimum lies.

Since there are several methods of measuring and expressing soil reaction, we were confronted at the outset with the problem of deciding which one to use. The lime requirement method as used by Johnson and Chapman is subject to the objection that it measures amount of acidity and not intensity of acidity. It is reasonable to believe that the activity of the parasite varies with the intensity of acidity. The so-called "hydrogen ion" method was therefore selected. The concentration of hydrogen ions (active acidity) may be determined either electrometrically or colorometrically. The first is the most accurate but too laborious and time-consuming for the testing of such a large number of soils. Also it is questionable whether such extreme accuracy is essential in this work. The colorometric method was therefore selected and all samples during the season of 1925 were tested with the double wedge comparator of Stirlen and Wallace. This method is rapid and was considered sufficiently accurate for the field survey. All tests were made on fresh soils immediately when brought in. (It was found that if these soils were kept for several days and dried out before testing they gave a more acid reaction.) Tests were therefore made while the soil was fresh, after which it was dried and stored for different tests.

Hydrogen ion Method of Measuring Soil Acidity.

The following non-technical explanation is offered for the benefit of those unacquainted with the hydrogen ion concentration method.

A soil that is exactly neutral (neither acid nor alkaline) is represented by the figure 7; alkaline soils by figures above 7, and acid soils by figures below 7. The further away from 7, the more acid or alkaline it is; thus 5 is more acid than 6, 4 more acid than 5, etc.

Although the figures of the hydrogen ion scale are from 1 to 14, only a small part of this scale is used in measuring soils. Up to the present we have not found a tobacco soil more acid than slightly below 4 or more alkaline than 7.3. Figure 6 may help to visualize the important points on the scale.

The method of preparing the solution for testing was as follows: Test tubes were filled with distilled water up to a mark indicating 10 cubic centimeters. The soil after thorough mixing was then added to the water until

it rose to the mark on the tube indicating 12½ cubic centimeters (4 parts of water to 1 of soil). After shaking thoroughly, the suspension was either centrifuged until fairly clear or permitted to stand until the supernatant liquid was clear. In many samples the water does not become clear, but

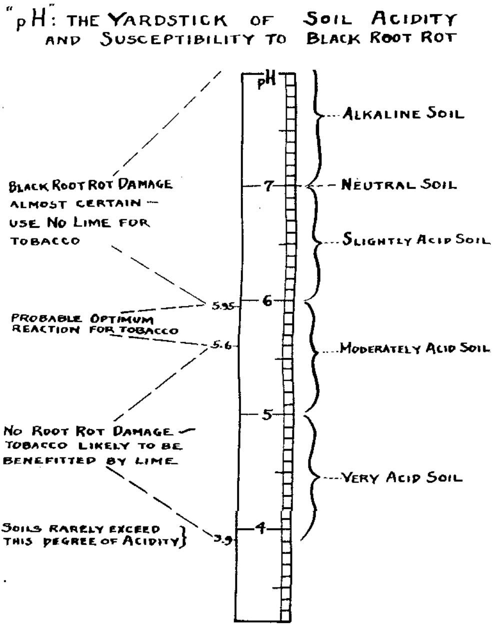

FIG. 6.—Black Rootrot in relation to Soil Reaction.

retains a murkiness which will not settle out for several days. This was particularly true of the less acid samples. The turbidity however, is compensated for by placing a tube of water without indicator in the comparator back of the double prism. Trials showed that the reaction was the same whether the solution was centrifuged at once, or permitted to settle until the next day. Two solutions were prepared from each sample—or more if the first two did not check closely. The indicators which were

found most suitable for this work were *brom thymol blue* at all ranges above 6.2, *brom cresol purple* from 6.2 down to 5.4, and *methyl red* below this. *Chlor phenol red* was used to some extent in the same range as *brom cresol purple*, but was not so satisfactory, especially in the upper half of the range. *Brom cresol green* gave results which were so clearly incorrect (possibly due to salt errors) that it was found to be worthless for this work and methyl red was substituted.*

Studies in 1925.

Samples were taken and records of field history made as the writers had opportunity during the summer and fall of 1925. Conclusions can be drawn only from tests of old tobacco fields. New fields (1-4 years in tobacco) may have a high reaction and still not be seriously affected with rootrot. The same may also be said of old fields which were formerly very acid in reaction but have been limed heavily within the last year or two. Soil tests under such conditions might lead one to expect severe infection when really the crop is not appreciably injured. It is for this reason that one must know the past history of the field as regards lime and fertilizer treatment and use considerable judgment in selecting fields for data. Even when soil conditions are made favorable for rootrot, it seems to require from 1 to 3 years before serious infection is noticed. The first year after heavy liming is usually marked by increased growth and the injurious effects of an overdose become apparent only afterward. The black rootrot fungus (*Thielavia basicola*) is present to some extent in all tobacco fields. We have not yet seen a field where the roots were found entirely free from its lesions if enough plants were dug and the roots carefully washed and examined. The reason that more fields do not suffer severely from rootrot is that the soil conditions are not right for abundant propagation and infection. As soon as those conditions are made right (by liming, principally) propagation increases and becomes apparent in reduced yield after 1-3 years as mentioned above. In collecting the data, fields cannot be listed as "infected" and "not infected" because all are affected. They must be classified according to the degree of injury which is apparent on the parts above ground. This injury is measured by lack of growth and consequent reduced yield. For purposes of classification the degree of injury was designated as none, slight, moderate, heavy, and very heavy. In fields of the first class, no injury had been noticed by the grower. In fields of the last class the injury was so severe that the tobacco was not worth harvesting. If the field was uniform, only one composite sample was taken. If, however, there were some parts

* The method used is thus described in detail for the benefit of any who wish to compare results or to undertake similar work. Results can be compared only when the same method of procedure is used.

of the field which showed evidences of rootrot while other parts appeared normal, two or more samples were taken from the same field. A few samples were also taken from seed beds which were affected with rootrot. Data on uninfected beds are of little significance because most beds are sterilized and rootrot will not be found in them even when the soil reaction is apparently favorable for it. The 234 samples which were tested during 1925 were distributed among 17 towns of the Connecticut and Housatonic Valleys as follows: Amherst 26, Northampton 2, Hadley 7, Sunderland 15, Granville 7, Southwick 2, Suffield 4, Granby 11, Windsor 81, Bloomfield 20, Simsbury 6, Hazardville 15, Ellington 14, East Windsor 2, South Windsor 6, Manchester 1, New Milford and neighboring towns in Housatonic Valley 15.

A complete presentation of the data on these samples is too lengthy to include here. The data as regards rootrot and reaction are summarized in Table XXV.

TABLE XXV. SOIL REACTION AND BLACK ROOTROT INJURY. SUMMARY OF 234 TESTS IN 1925.

Reaction, pH	Number of Soils tested	Degree of damage from rootrot				
		None	Slight	Moderate	Heavy	Very heavy
Below 5.5	8	8	..	..	..	..
5.5 -5.6	11	11	..	..	..	..
5.6 -5.7	25	25	..	..	..	..
5.7 -5.8	56	56	..	..	..	..
5.8 -5.9	49	49	..	..	..	..
5.9 -5.95	23	23	..	..	..	..
5.95-6.0	5	1	4	..	..	..
6.0 -6.1	8	1	6	..	1	..
6.1 -6.2	7	1	2	4	..	..
6.2 -6.3	10	..	1	4	5	..
6.3 -6.4	7	..	..	1	6	..
6.4 -6.5	8	..	..	..	4	4
6.5 -6.6	3	..	..	..	2	1
6.6 -6.7	2	..	..	1	..	1
6.7 -6.8	2	..	..	1	..	1
6.8 -6.9	2	..	..	..	..	2
6.9 -7.0	3	1	..	..	..	2
7.0 -7.3	5	..	..	..	..	..
Total	234	176	13	11	18	16

An inspection of this table shows that:

1. The 68 samples taken from infested fields or beds all had a reaction of 5.95 or above.

2. The most severe infection was from 6.4 upward, i. e. those soils which are nearly neutral or slightly alkaline.

3. Of the 176 samples from fields which showed no injury, all but four were below 5.95. Lack of infection on these four may have been due to the fact that the reaction had been brought up to that point only within the last few years.

It is perhaps too early to draw definite conclusions because more extensive survey may reveal some fields which are not in agreement with those tested and because a different kind of season may shift the critical point upward or downward (since Johnson and Hartman show that soil temperature also plays an important role.) Results up to date indicate that the critical point between rootrot and safety is in the neighborhood of 5.95. We have yet to find a field suffering seriously from rootrot at a more acid reaction than this. Apparently the problem for the grower is to keep his soil below this point. How shall he do this? Fortunately, most soils in the tobacco sections are naturally more acid than this. In the Connecticut Valley the only cases of a more alkaline reaction we have observed were due either to heavy applications of lime or ashes or to location on heavy, low places in the field *into* which the alkaline elements leach from the other parts and *from* which the leaching seems to be very slow, thus resulting in an accumulation of alkaline substances. From the typical sandy tobacco soils the alkaline elements leach rather quickly, so that if applications of lime or wood ashes are avoided for a few years the soil naturally reverts to an acid condition. In the heavier soils where leaching is slower the case is not so simple. There is no fertilizer or other fairly inexpensive substance which can be applied to the soil to make it quickly acid comparable to lime for making soil alkaline. Large applications of sulfate of ammonia and sulfate of potash, however, will gradually produce an acid condition. The use of these salts in place of nitrate of soda or carbonate of potash is recommended in soils which are too nearly neutral, but rapid results should not be expected. It is perhaps best to avoid heavy, naturally neutral or nearly neutral soils for tobacco and on the lighter soils when the reaction is too high to avoid the application of alkaline substances.

However, it must be remembered that there is also a danger of getting the soil too acid. As previously mentioned, there is good evidence that lime, wood ashes and carbonate of potash are beneficial in tobacco culture. In fact it seems that the more nearly neutral a soil can be kept without incurring rootrot, the better the tobacco which is grown on it. In other words, the grower should attempt to keep it up as near 5.95 pH as possible without actually getting it above that point. Among the fields tested during 1925, there were many which had the reputation of producing the best tobacco in their respective neighborhoods and were selected for tests on that account. The larger part of these showed a reaction between 5.6 and 5.9 pH, the maximum number centering around 5.85. An occasional good field could be found as acid as 5.1 but on most of those below 5.5 the owners did not consider the growth satisfactory. Such fields would probably be benefited by applications of lime or wood ashes.

Soil conditions in the Housatonic Valley are somewhat different and need a few words of explanation. This part of the state is characterized by outcroppings of limestone and the soil is frequently called a limestone soil. One would naturally expect to find such a soil neutral or slightly alkaline, in which case it would not be possible to grow tobacco profitably on account of rootrot. Yet we know that good tobacco is grown in the Housatonic Valley. In order to see what the rootrot situation was there, the writers made a partial survey of the region about New Milford and tested the soil from 15 tobacco fields. The best tobacco fields were on the sandy terraces along the river and its larger tributaries, and the soil was no more alkaline than corresponding fields in the Connecticut Valley. Rootrot was causing no damage here. Other fields were located where there were outcroppings of limestone either in the fields or in such a position that there was direct wash from them into the fields. Such fields were suffering severely from rootrot and the reaction of the soil was found to be well above 6.0 pH. That more such fields were not found was probably due to past experience of the farmers which had taught them that tobacco could not be grown at a profit on these fields.

Many growers are interested in this problem and are anxious to know if lime may be safely used or if on the other hand an effort should be made to get their fields into a more acid condition. Soil samples may be brought or sent to the tobacco station for testing and while the number of pounds of lime to use can not be stated exactly, the test is sufficiently accurate to serve as a safe guide.

TOBACCO DISEASES OBSERVED IN 1925.

P. J. Anderson and G. P. Clinton.

The following paragraphs record only the observations the writers have made on the diseases prevalent in 1925. A more comprehensive bulletin treating of all the diseases will be published at a somewhat later date.

Brown Rootrot.

This is probably the least known of all the diseases of tobacco and yet there is no more important disease problem which confronts the Connecticut Valley tobacco grower. Scattered all over the valley are fields which once grew the best tobacco but which are now being rested or turned to other crops because tobacco will no longer grow there. The fields have become "tobacco sick" or

"run out." Many other good fields have patches of various sizes *where the owner doesn't expect to make the crop pay. Some of* these are cases of black rootrot, some are unexplainable, but the majority are brown rootrot cases.

The symptoms of brown rootrot as seen above ground in the field are the same as black rootrot, viz., slow growth, yellow narrow pinched leaves which wilt on hot days, premature topping

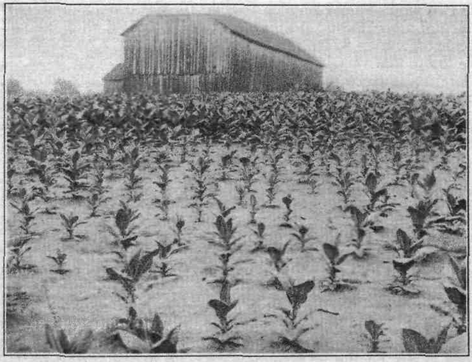

FIG. 7.—Brown rootrot "patch" in an otherwise good field of Havana seed. 1925.

out resulting in undersized plants and dead yellow tobacco when sorted. When the roots of such plants are washed and examined, many of the smaller ones, especially at the very base of the stem, are found to be dead and brown. There are no black segments of roots or enlarged rough black lesions such as one finds in the case of black rootrot. The stunted growth above ground is apparently caused by the destruction of so many of the roots with consequent starvation of the plant. Later in the season when the new roots are developed from the stalk, the dead lower roots are not so much in evidence.

The *greatest gap in our knowledge of this disease is our ignorance* as to the case of it. If we sufficiently understood the cause, it would probably not be so difficult to find some method of preventing it. In contrast to black rootrot, no one organism

has been found associated with it. Yet there is some evidence that it is caused by an organism, although the responsible one has not been isolated. The fact that it can be prevented by sterilizing the soil with steam or formaldehyde lends support to this view since such treatment would be expected to kill the causal organism. Yet it is quite possible that such sterilization may have other effects on the soil. The fact that the disease can be prevented by spreading the soil out in a thin layer and aerating it for two weeks would be very unusual for a disease caused by the attack of an organism, since we are not acquainted with any pathogenic organisms which can be destroyed by such a mild measure. We know that certain preceding crops or cover crops have considerable influence on its prevalence. The writer has shown, in experiments in Massachusetts for instance, that timothy used as a cover crop favors brown rootrot. Hence there are those who see in brown rootrot only a crop effect. This might operate, but it could be only one of the operating factors at best since we have many fields where rootrot affects only small patches but the whole field has been cropped alike for many years. Up to the present, no practical remedy has been found. Cover crops should be avoided. Also nothing will be gained by "resting" the land to timothy for a few years, as has been tried by some. It will do better in continuous tobacco. The reaction of the soil seems to have no influence as we have observed during the soil tests of 1925. Growers have also learned from experience that application of additional fertilizer does not help it.

In view of the seriousness of the situation and the little progress that had been made in finding a way to combat it, a combined attack on the problem was planned in the spring of 1925 by representatives of the United States Department of Agriculture, the Botany Department of the Agricultural Experiment Station and the Tobacco Station. Field plots for this investigation were located on a badly affected lot in Poquonock. It was planned that these plots should be continued for at least three years. This is being supplemented by laboratory and greenhouse tests. The experiments have not progressed to a point which warrants a report at this time.

Other Diseases in 1925.

Wildfire. The first case of wildfire in the seedbeds seen by the writer was on May 1. No other case was found for two weeks and even as late as May 30 only ten cases had been reported in the Connecticut Valley, although hundreds of beds had been examined. In comparison with previous years, seed bed infection was thus rather light. More developed during the first two weeks of June. A few cases were found in the Housatonic

Valley during the second week of June. First cases in the field were found at about this same time. From this time on, more and more cases were found in the field until their number was surprisingly large in consideration of the light seed bed infection. It was a season of pretty heavy rainfall in most tobacco sections and it was feared that many of the crops would be ruined. Happily such was not the case. Not only were there no crops ruined—as the writer has frequently seen in recent years—but the amount of wildfire in the harvested crop has been almost negligible as far as we have been able to judge from visiting a considerable number of sorting shops and from many reports.

The unexpected behavior of wildfire during 1925 will be interpreted by some as an indication that this disease is losing its virulence. Such may be the case, but it would be dangerous on such an assumption to neglect any precaution against it in 1926. This year may witness a virulent epidemic.

Some growers tried field spraying with Bordeaux mixture where the infection was serious and believed that they gained a measurable degree of control, but the data are not so convincing in view of the fact that it was not very serious even in the unsprayed fields when the tobacco was cut.

At this point it is well to repeat that every effort should be made to keep it out of the beds since this is the most vital point of attack. It has now been pretty well demonstrated that the wildfire germs do not winter in the soil, but that the principal source of spring infection is the tobacco shed where they winter in infected leaves or on the dry floors. From here it is carried to the beds on tools, feet of workmen, sash, boards, or may be blown. Every precaution should be taken to prevent such transfer of the germs. If the beds are very close to the sheds the grower should be careful to hang any wildfire tobacco he may have in the other sheds or move the beds so that they will be further away from the sheds. The most important measure in control of wildfire is the spraying or dusting of the beds. Some prefer the dust and some the liquid spray. Either will control the disease if it is regularly and thoroughly applied. After having had experience with both, and watching their operation in the hands of practical growers for four years, we are inclined to recommend spraying with home-made Bordeaux mixture as easiest, safest and cheapest. We know of few growers who, after trying both, have not come to the same conclusion. If the stock solutions are made up beforehand, it is not very much work to spray twice a week and keep the plants healthy all the time. There is no stunting of the plants, no dust-burn; other diseases are also controlled as well as flea beetles. Any growers who have not had experience with Bordeaux mixture and contemplate using

it should send to the Tobacco Station for full directions for preparing it. A member of the staff will be glad to visit as many growers as desire in order to demonstrate methods of preparation and application.

Extreme care should also be taken not to set plants from a bed which has wildfire. A diseased plant has only about 1/3 as many chances of living when set, as a healthy plant has—not to mention the later effects of spreading the infection in the field.

Dust burn and Fertilizer burn. Dead spots on the leaves of plants in the beds resulting from the application of copper lime dust or of strong fertilizers such as nitrate of soda or fish were unusually common during the spring of 1925. The fertilizer burns may be prevented by care in washing the fertilizer off the leaves with water after application. The conditions which cause dust to burn in some cases and not in others are not so well understood. In some cases, at least, it is caused by putting the glass back on immediately after dusting wet plants and keeping the copper in solution for a long time.

Paris green burn. This injury was prevalent in many fields when the poison bait against cutworms was applied directly on the plants. It produces round dead spots of various sizes in the leaves. Frequently the grower confused it with the lesions of wildfire but the characteristic yellow halo of the latter spot was absent.

Angular leaf spot (Blackfire). This bacterial disease, which is considered more destructive than wildfire in the South, has not proved of serious import in New England. Anderson first reported it in Massachusetts in 1922 but it caused no serious damage at that time. It was also observed during the same year in Connecticut by Clinton but has been reported only once since until 1925 when several rather serious cases were observed. It produces numerous dead spots, commonly somewhat angular, on the leaves. Although there is some yellowing about the margins of the spots, it does not develop the broad definite halo of the wildfire spots. One of the worst cases seen was in the Station Broadleaf field. Many of the lower leaves were worthless when sorted. The effect on the cured leaf is just the same as that of wildfire. It is to be hoped that this disease is not destined to increase and become as destructive as it is in the Virginia and Kentucky districts. There is some basis for believing that the disease will not be serious here since attempts to inoculate plants have failed.

Hollow Stalk. This disease, also caused by bacteria, was found in a few fields but the damage in the aggregate has not been large. It appears first after topping and reduces the pith of the stalk to a wet black rotten mass which later shrivels and dries, leaving the stalk hollow. The lower leaves also become affected,

the midribs become black and they sometimes rot off at the stalk and drop away. The cases observed have not been sufficiently widespread to warrant special control measures.

Bed Rot. (Damping off) This disease is present every year and may affect the plants in any stage of growth in the beds. The worst cases observed during the past year were after the plants were well grown and almost ready to pull. Large patches in the beds were rotted completely off. These bad cases were invariably in beds which had been sowed too thick. When the plants get large the leaves are so tight together that there is no circulation of air, resulting in a constant state of high humidity around the bases of the stalks at the surface of the ground. Such conditions are ideal for the development and rapid spread and infection of the fungi which cause bed rot. No experiments have been undertaken on this disease during the year, but it has been found that beds which are kept thoroughly sprayed from the first are rarely affected with bed rot. The disease was checked in some bad cases by thoroughly ventilating and drying out the beds. Steam sterilization is advised and does much to prevent it from starting, but some of the bad cases of the year were in sterilized beds. We have never found bed rot in beds which were properly sterilized, ventilated, sprayed, planted not too thick and not overwatered. After the plants have developed to the stage when the stem is hardening there is little danger from bed rot.

Oversterilizing beds. Several cases came to our attention during the year where injury was apparently caused by too intensive or too long steaming. In one case a grower sterilized for about two hours at 120 lbs. pressure. He was unable to make tobacco plants grow at all on this soil. Another grower with an acre of beds sterilized some in the fall and the others in the spring. All were on the same kind of soil and all treated alike in every other way and seeded at the same time. The fall-sterilized beds were entirely satisfactory. In the spring-sterilized beds the seeds were said to have sprouted all right but they became thinner every day and probably 80% of them died before they were half grown. No evidence of disease could be found on those which died. Although the evidence all indicated that the damage was due to steaming, an experiment was begun during the last week of May by way of confirmation. One of the beds where the loss had been the heaviest was worked up again. One part of it was then steamed again, one was treated with formaldehyde and the third part was untreated. From another part of the bed the soil was removed and new soil put in. All were then reseeded with the same lot of seed as had been used before. The seed sprouted normally on all, but the plants became thinner day by day on the steamed part until soon there were hardly any left. The stand remained very thick on all the others. Since there was a good

stand in the part which was not sterilized, it was apparent that the injurious influence of the early spring steaming had now passed away. The grower had waited at least ten days after sterilizing the first time before sowing, but apparently the injurious influence was of longer duration in this case.

Mosaic. "Brindle" was present in about the usual amount in all parts of the tobacco sections. Some unusually virulent cases occurred about Middletown in the extreme south end of the tobacco country. In some of these fields fully 95% of the plants were diseased. The effect on the plants was also unusual. The leaves were not merely mottled with areas of darker and alternating lighter green as in the ordiuary case. The younger leaves especially were distorted and wrinkled and the dark green areas stood out like huge blisters from the surface. The leaves looked like peach leaves affected with the parasitic leaf curl. The growers stated that they had not noticed the disease in the beds. One attributed its virulence to a heavy application of nitrate of soda made shortly before the disease became so prominent. Just why it should be so exceptionally virulent in the fields in that particular neighborhood this year is difficult to explain.

Frenching. This disease, characterized by narrow but heavy strap-like chlorotic leaves, was formerly confused with mosaic and the leaves do frequently have a mosaic character. The number of leaves is also usually increased, especially in the upper part of the plant. Very little of this disease was noticed during the summer in the Connecticut Valley, but a few fields in the Housatonic were found to be rather seriously affected.

Lightning Injury. On account of the frequent electric storms during the early growing season, in the field a number of cases of lightning injury occurred. Some of these which were observed by the writer were three or four rods in diameter. Usually all the plants in the center were quite dead and around this a zone of stunted and deformed plants, the degree of injury gradually diminishing with the increasing distance from the center. When the dead plants were examined a slender cavity was found in each corresponding to the pith. When the marginal plants were allowed to grow they made a one-sided deformed growth.

Injury from tarvia fumes. One grower was very much puzzled at a peculiar injury to his plants along the side of a macadam road. When first examined the leaves had a glistening, varnished appearance. After a few days, parts of the leaves died, the dead places being either marginal strips or irregular areas between the veins. A thorough investigation of the case showed that it had been induced by fumes blowing on to the plants from tarvia which was being spread in a hot condition on the road with a tarvia "sprinkler." Although there were tobacco fields on both sides

of the road, no injury occurred on the side from which the wind was blowing when the "sprinkler" came along.

Curly dwarf. This rare and peculiar disease was again found in fields around Windsor Locks where it had been found in previous years by Mr. Slagg. The plants are very much stunted in growth, the leaves are distorted and wrinkled, and set very close together. The whole aspect of the plant reminds one more of a cabbage or cauliflower. The plants are worthless. Fortunately the disease is confined to a very small locality and a very small percentage of the plants in a field are affected. The cause is entirely unknown.

Yellowing from fertilizer leaching. Shortly before harvesting, it became apparent to anyone who travelled the tobacco section very extensively that something was wrong in a great many of the fields. The growth was not all that it promised to be early in the season. More particularly it was noticeable that the leaves on the lower part of the plant were "yellowing." There was also more than the usual amount of spotting, particularly in the broadleaf. After the tobacco was cured this same condition resulted in a high percentage of dead, yellow and double color tobacco which was very largely responsible for the disappointing quality of the 1925 crop. Most of the tobacco sections had very heavy rains during the middle of the growing season and, without having absolute proof for our conviction, we are inclined to believe that these rains were responsible for the later yellowing by causing loss of the nitrogen through leaching. If these rains had been followed immediately by rather heavy applications of quickly available ammoniates such as fish and nitrate of soda, it is probable that a great deal of this injury could have been prevented. When, however, the grower waited until the symptoms of nitrogen shortage were visible, it was so near harvest that he feared to stimulate growth by application of extra fertilizer at that time.

Physiological Spotting of Broadleaf. Soon after the heavy rains of midseason, large brown dead spots began to develop in the broadleaf to an extent which caused alarm to many of the growers. Since no organisms were found associated with these spots, it seems likely that they were of physiological origin. The most characteristic kind of spot was the "star and crescent" spot, characterized by a small round dead area encircled incompletely by a slender curved dead line. The whole "star and crescent" varies in size, from a quarter of an inch to two inches across. Various other irregular shaped spots occur among them. These spots are quite different and distinct from the little round white spot characteristic of the John Williams type of broadleaf. The writer has noticed in previous years that these spots frequently come soon after heavy rains but the connection between the two is not plain. No method of preventing these spots is known.

TOBACCO INSECTS OBSERVED IN CONNECTICUT IN 1925.

W. E. Britton and P. J. Anderson.

The following pages include our observations of insect injuries to the tobacco crop during the season of 1925. Some of the chief features were the unusually severe outbreak of wireworms, which caused great injury, the prevalence of cutworms, flea-beetles, seed-corn maggots, and a new form of injury caused by the larvae of a crane fly. Most of the field observations of the past season were made by the junior author, but these have been supplemented by records, identifications and illustrations from the Department of Entomology of the Station in New Haven, and this paper is the joint effort of both authors.

WIREWORMS.

The first reports of wireworm trouble came to the Tobacco Sub-station on May 25. During the next two weeks, numerous reports were received and the junior author visited a number of infested fields, some of which were near the Tobacco Sub-station so there was abundant opportunity to keep in daily touch with the situation. On June 2, the epidemic was at its height, but the extremely hot weather of that week caused the wireworms to go deeper into the ground, so by June 15 it was hard to find one except by digging down deep under the rows. No reports after that date came to our attention. The most severe cases observed were on plantations of shade-grown tobacco, though many cases were also reported in outdoor tobacco fields.

One grower of shade tobacco had 84 acres under cloth, and 40 acres of newly-set plants were ruined. All of it was reset once, much of it twice, and some of it three times. At the second resetting, the wireworms appeared to be just as thick as at the time of the first resetting. On some of his fields, 95 per cent of the plants were dead when the junior author first saw them. The stalks were completely riddled with tunnels, as shown in Figure 8. Usually one or more wireworms still remained in the stalk, and from three to six others could be found in the soil close around each plant, but in some cases the numbers ran up to 18 and even 24 wireworms per plant. Apparently, all had been attracted to the plants and were gathered immediately around them, and only rarely could one be found in the soil between the rows.

The writers visited this field on June 2, in company with Dr. Philip Garman, Assistant Entomologist of the Station, and some of the wireworms were collected and taken to the laboratory in New Haven. Many adult click beetles were observed resting

upon the cloth, both inside and outside the tent. They were not known to be connected with the wireworms but it was suspected that they might be the adult stage, and some of these also were collected.

The writers together visited the field again on June 5, when it was found that most of the wireworms had disappeared by going deeper into the soil. Some wireworms could be found by digging for them, but very few were seen around the plants or near the surface. Adults on the cloth were also less numerous than on

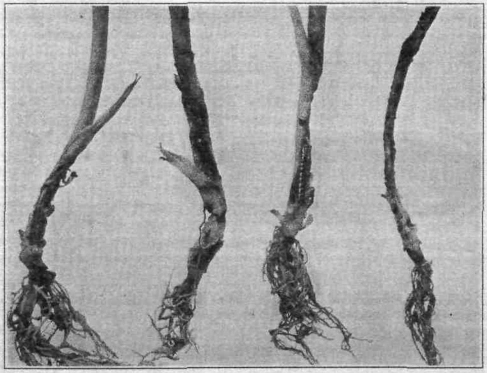

FIG. 8.—Injury to young plants by wireworms, natural size.

June 2. When one of the fields was plowed late in the fall, wireworms were observed near the bottoms of the furrows.

Identity of the Species: Mr. B. H. Walden, Assistant Entomologist of the Station, examined the wireworms and identified the species as *Limonius agonus* Say, by comparison with some named material in the collection and this identification was afterward confirmed, and the adult beetles pronounced the same species, by Mr. J. A. Hyslop of the Bureau of Entomology, at Washington, D. C. The general appearance of both wireworms and adult beetles is shown in Figure 9. Mr. Hyslop visited East Windsor Hill in 1917 and found this species, which he calls the eastern field wireworm, causing considerable damage to newly-set tobacco, though the attack was much less severe than this 1925 outbreak.

We also have material from Hockanum, July 1, 1920. Little is known about the life history of the eastern field species or the length of the wireworm stage. With other kinds according to species, this stage may require from two to six years.

Though perhaps *Limonius agonus* is the most common wireworm attacking tobacco in Connecticut, we have other material in the Station collection identified by Mr. Hyslop and bearing the

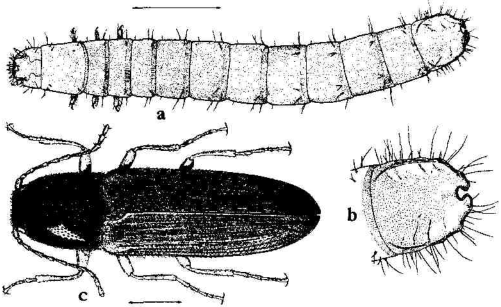

FIG. 9.—The Eastern Field Wireworm, *Limonius agonus*, a. larva; b. posterior segment of larva; c. adult beetle. All enlarged. Natural length of larva and adult indicated by the lines.

following records: *Asaphes* sp., Portland, June 12, 1906, B. H. Walden; *Melanotus* sp., Poquonock, May 28, Windsor, May 29, 1921, E. H. Jenkins.

All wireworms are the grubs or larvae of click beetles, which form the family Elateridae, of which there are nearly 100 different species occurring in Connecticut.

CONTROL OF WIREWORMS.

Probably no group of insects has so baffled the tobaccco grower as has the wireworms. For most of the tobacco insect pests and diseases some partial or complete remedy has been found, but before the wireworms the farmer has been helpless. No remedy was known. When the wireworms came, he had his choice of abandoning the field, or part of the field, for that year, or restocking every few days until the worms were driven down by hot weather. Since frequent restocking results in objectionable differences in maturity at harvest and considerable financial loss, many

prefer to harrow the whole field and reset with the setter. In cases of bad infestation, however, it is frequently necessary to repeat this operation several times before an even "stand" is secured. Wireworm infestation is not equally severe every year. Some years they cause little or no damage; the next year may see an epidemic. Growers have noticed, however, that there is a tendency for them to appear in cycles. If they are injurious on a certain field or part of a field, it is probable that they may occur in the same place the following one or two years. Only rarely is a field equally infested throughout. More often the damage occurs in spots which may cover several acres or may be no more than a rod across. When the wireworms are numerous in the soil, the plants die within a few days after setting; in fact they frequently never recover from the initial wilt after setting. If, however, wireworms are few, the plants may not die at once but remain stunted and sickly. Some recover entirely and make a normal but usually belated growth.

Various remedies have been tried in the past, but without signal success. Fall plowing is frequently recommended but growers who have made careful tests of this method report that it has given no relief. One prominent grower, who considers the wireworm problem as the most serious with which the tobacco farmer has to contend, informed the writers that one of the most serious infestations he ever had was on a lot which he had plowed in the fall. The use of camphor dissolved in wood alcohol and mixed with the water in the setter barrel has also had its advocates, and a few claim to have had success, but others who have spent hundreds of dollars for camphor and alcohol state that the total result has been the repelling of wireworms for a few days with subsequent return and destruction of the crop. Many other substances such as turpentine, various soaps, etc., have been used in the setter barrel and still have their advocates but none of them stand the test when the infestation is serious. Others have tried soaking potatoes or corn in mercuric chloride, formaldehyde, Paris green and other poisons. Wireworms are attracted by these baits which are soon riddled with their tunnels, but they are apparently not killed. Failure may be due either to the extreme resistance of wireworms to such poisons or to the fact that the poisons do not penetrate the baits. At any rate, this method has not been generally successful. Growers sometimes think that the methods they employ are successful because the worms disappear very soon after some remedy has been tried. It is very easy to be misled, however, because of the peculiar habits the wireworms have of disappearing as suddenly as they came. When the soil warms up sufficiently they dig deeper into it and leave the plants on which they have been feeding. If this migration into the deeper soil happens to coincide with the time the grower applied

some remedy, he is prone to believe that the remedy has been successful, although it may have had no effect whatever. This habit of the wireworms also probably explains why during some years there is no wireworm injury, since the soil warms up earlier some seasons than others.

EXPERIMENTS AT THE TOBACCO SUB-STATION.

Carbon disulfide; On June 2, Dr. Garman and the writers made a carbon disulfide soap emulsion in the setter barrel and applied it to rows which were being reset. Two rates of application were used; first, one part of carbon disulfide to 360 parts of water, and, on other rows, one part to 720 of water. Three days later it was found that the stronger mixture had killed all the plants, and the weaker mixture had failed to kill the wireworms.

Calcium cyanide: Another remedy suggested by the entomologists was calcium cyanide compound, or "Cyanogas," a poison which had been used in other parts of the country against wireworms in beans and other vegetables. The method used by the bean growers in California is to sow a bait crop of split beans, or other inexpensive seeds, in the field before it is time to plant the main crop. The wireworms from all sides congregate in these seeds and plants. The Cyanogas is then drilled into the soil along the row of infested plants and the fumes kill the wireworms. At our request the American Cyanamid Company of New York, manufacturers of Cyanogas, sent one of their experts to Windsor to investigate the situation and to aid in testing the toxicity of Cyanogas against the tobacco wireworm and in working out a practicable method of using it. Unfortunately at the time Mr. Rice, their expert, arrived, on June 11, the epidemic was subsiding and extensive field experiments were out of the question. Some experiments on a small scale, however, were made to test the toxicity of Cyanogas on the wireworms and the effect it had on the plants. Such experiments seemed essential as preliminary to field experiments, which it is hoped will be tried in the season of 1926. Some of these may be briefly described.

Toxicity to wireworms: When a wireworm is placed in direct contact with Cyanogas, it dies within a minute or two, but in the soil it is seldom that many come into direct contact with the poison. In order to see how the fumes would pass through the soil, 24 wireworms were distributed in the soil of a box one foot square. A small teaspoonful of the cyanide was then buried at the center of the box about three inches below the surface. Eighteen hours later the soil was sifted and 21 of the worms were dead, while three of them were barely able to move.

With the idea that the enclosing walls of the box might have some effect, the next test was carried out in the open field. Eighty

wireworms were distributed in the soil of a row of plants, eight feet long. A thin line of cyanide was then drilled in the row two inches deep. Two days later the row was dug up but only 60 of the wireworms could be found. All but three were lifeless and these three were very sluggish. This soil was not screened and it is not always easy to find them in the open field without screening. Undoubtedly more of them could have been accounted for by more careful search, but some may have been far enough away to escape the fumes and have crawled away.

In a third test, Mr. Rice distributed 140 wireworms in a narrow box ten feet long and a foot deep and wide, and then set a row of plants in the center. After a few days, when the wireworms were working well in the plants, a thin line of cyanide at a rate calculated to equal 100 pounds per acre, was drilled two or three inches deep along the row. Then after a few days the soil was sifted, but only 60 of the wireworms could be found, all of which were dead. The box was thought to be tight enough to prevent escape of any wireworms, but the soil and water had warped it so that there were cracks large enough for them to escape, which they probably did before the application of cyanide was made. Not a live wireworm was found in the box.

Effect of Cyanogas on tobacco plants: When the cyanide is placed directly in contact or even very near a tobacco plant, it wilts and dies within a few hours. It is therefore not possible to use it directly on plants which one wishes to save, but of course when the plant is affected with wireworms, one does not wish to save it. The important question is: how soon after applying the cyanide to a soil will it be safe to set the plants? In order to test this, a row of cyanide was drilled in at the rate of 100 pounds per acre. After four days a part of the row was set with plants, directly over cyanide. An additional part was set each following day until the row was all set at the end of ten days. All were watched carefully for any signs of wilting, stunting, or other injury, but all grew alike into strong healthy plants. Apparently four days was ample time in this test for the toxic effects to pass out. It should be mentioned, however, that in this test there was a *heavy rain* during those four days which may have had some effect in dispelling the toxic substances. Experts of the American Cyanamid Company recommend seven days before setting.

Another important question to be answered is: will the cyanide have any effect on the quality of the cured leaf? In order to test this, four rows of Havana seed tobacco were set where cyanide at the above mentioned rate had been applied six days before. Four alternating rows were set at the same time, but where no cyanide had been drilled. Throughout the season the tobacco was watched for any differences in growth but none were

apparent. The rows were kept separate at time of harvesting and sorted separately. No difference in quality could be seen at time of sorting. Neither were there any differences when burn tests were made.

From these preliminary tests we may conclude that:

1. Calcium cyanide is highly toxic to the wireworms not only when in contact but is able to kill them through several inches of soil.
2. Most of the wireworms during the danger season congregate in or very close to the plants, leaving the more distant soil almost uninfested.
3. Although Cyanogas kills tobacco plants when first put near them in the soil, its toxic effects disappear within a few days and it is safe to set plants there at least within a week or possibly sooner.
4. Cyanogas seems to have no injurious effect on the quality of the cured leaf.

Suggested Method of Application: Pending more extensive field trials we are not yet ready to give unqualified recommendation to the cyanide method, but it is by far the most promising method which has been tried. We make the following suggestions for those who are troubled with wireworms and are willing to try something, even though success has not been fully demonstrated, rather than to do nothing and see their fields ruined. The average grower will not do anything until he finds his plants already infested. When this stage is reached it is hopeless to try to save any of the plants in the infested area. It is best then to drill the Cyanogas into the row as deeply as can be conveniently done with the least disturbance of the soil. For this purpose the writer has found a Planet Junior hand seed drill very convenient. Other drills of similar construction and on which the outflow can be regulated may be used. For more extensive work a larger drill operated by horses such as a corn drill or a fertilizer attachment on a tobacco setter could be used. Cyanogas is a fine powder which does not lump and flows freely from the drill. All the plants which remain in the row will be killed along with the wireworms. A week later the plants may be set in the same row. This method has the disadvantage of delaying the final setting of the plants. Another method is to bait and kill the wireworms before the field is set in the first place. This may be done by drilling corn or other seeds in the field ten days before ready to set and then killing the wireworms which gather in the row by the method mentioned above. If the grower is uncertain as to whether his soil is infested with wireworms, he may find out by planting a few rows of corn across the suspected places and see whether or not wireworms attack it. It is not necessary to wait until the corn comes up, since it will be attacked within a few days if the wireworms are there. If it has an abundance of tobacco plants, the grower may find it best to set these as the bait crop. It has also been suggested that the bait rows be

located somewhat to the side or between where the final rows will be set. In this way the cyanide may be applied and the final setting made immediately afterward without a week of delay. Yet another method may be used on fields where infestation is not severe enough to warrant replacement of the entire stand. If there is only an occasional plant affected, the grower may make a hole beside each affected plant with a dibble or a stick, insert a half teaspoonful of Cyanogas and close with dirt. After a few days the field may be restocked with safety.

The Tobacco Sub-station will be glad to coöperate with any growers who wish to try these methods and to learn of results obtained by the use of Cyanogas.

Cutworms.

Cutworms cause more or less injury each year in tobacco fields and were unusually troublesome in 1925. They are the larvae or

Fig. 10.—Moth of the black cutworm. Natural size.

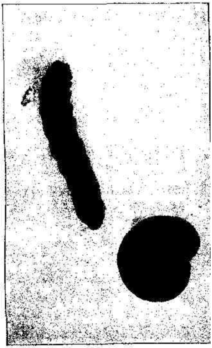

Fig. 11.—The variegated cut worm. Natural size.

caterpillars of certain species of Noctuid moths, a dozen or more different species having been recorded as causing injury. Though the different kinds have varying habits and life histories, with most of them there is one annual generation, the eggs are laid on grass, weeds or other plants in late summer, and the larvae hatching from them feed upon the smaller weeds, grass and other vegeta-

tion of the field, becoming about half-grown on the approach of cold weather, going into the ground or under rubbish to gain protection during the winter. When warm weather arrives in spring and vegetation begins to grow, they emerge from their winter quarters and resume feeding. When the land is plowed, the weed growth is turned under and the cutworms have difficulty in finding food and accumulate great appetites. Consequently they are all ready and waiting for a full meal, and proceed to take it as soon as the plants have been set. Their attacks necessitate a great deal of resetting followed by a lack of uniform maturity at harvest time.

Cutworms do their feeding at night and hide during the day, usually curled up just beneath the surface of the soil, where they may be found by hunting for them around the base of injured plants. The adult moths are mostly grayish or brownish to black in color and also fly and lay their eggs at night and rest during the day in protected places on barns, fences, trees, etc. One of the commonest cutworms in tobacco fields and vegetable gardens in Connecticut is the black cutworm, *Agrotis ypsilon* Rott., the adult of which is shown in Figure 10. The variegated cutworm is shown in Figure 11.

CONTROL OF CUTWORMS.

The best growers now control cutworms by the use of a poisoned bait consisting of a mixture of Paris green with some diluent such as brand, hominy feed, or middlings. There are two methods of applying the mixture: (1) on the row at the time of setting, and (2) broadcasted before setting. Those who applied it broadcast beforehand seem to have been more successful this year in controlling the cutworms. This is to be expected because if the bait is applied at time of setting, the cutworm will hardly leave its natural food, a tender plant, and seek the dry bait. Consequently many plants will be eaten and must be replaced. If, however, the bait is applied beforehand to the bare ground there is nothing else for the cutworm to eat, and it will naturally be attracted to the bait, and should be killed before the crop is set. In order to test the two methods side by side, alternating plots were treated by each method and the number of plants destroyed by cutworms was recorded. Unfortunately, this field proved to be one of the few in the Connecticut Valley which was not seriously infested with cutworms even where no bait was used. The final results were all in favor of the application before setting, but since the infestation was very slight on the untreated plots, the results were not very convincing. The mixture used in these tests was made as follows:

Bran (1 bag)		100 lbs.
Paris green		5 lbs.
Oranges or lemons		½ doz.
Cheap molasses		4 qts.
Water	about	15 gals.

The amount of water to be used must be determined by the condition of the mixture. Enongh must be added to make the bran stick together in small lumps so that it can be broadcasted by hand, but not enough to "puddle" it. The bran and Paris green were first mixed dry by shoveling over, as one mixes fertilizer on a platform. The oranges were cut into very small pieces and mixed with the water and molasses. After thoroughly stirring, the sweetened water was sprinkled over the bran in order, while shoveling, to mix thoroughly. The mixture was broadcasted on the field just before night, several days before the tobacco was set. The oranges and molasses are said to attract the worms to the poisoned bran.

Flea-beetles.

The cucumber or potato flea-beetle, *Epitrix cucumeris* Harris, often causes injury to newly-set tobacco plants, and even afterwards the large leaves are frequently eaten. Flea-beetles usually attack the under surface of the leaves, where they eat away portions of the tissue, giving a spotted appearance. The injured spots become dry and drop away, leaving holes through the leaves as shown in Figure 12. Sometimes the beetles feed upon the upper surface with similar results.

In most tobacco growing regions, particularly southward, such injury is caused by the tobacco flea-beetle, *Epitrix parvula* Fabr., but in all the collections made from tobacco plants in Connecticut only *E. cucumeris* was obtained and so far as we know, *E. parvula* has not been recorded from Connecticut.

The cucumber or potato flea-beetle is about one-sixteenth of an inch in length, black in color, with rear legs enlarged and fitted for jumping. It also has wings and can fly. It is shown in Figure 13.

The junior author in 1925 made an interesting observation on the ability of the beetles to distinguish between the different kinds of tobacco. In the shade tent at the Tobacco Sub-station, there were under experiment a large number of selections and hybrids of Cuban tobacco. During the summer it was noticed that the beetles gathered on one particular row, a hybrid near the center of the field. After the tobacco was cured and this hybrid came to the sorting bench, it was found to be so riddled with small holes that it was not worth sorting. This was the only row on the whole field which was severely injured, and rows on either side of it

showed hardly a trace of flea-beetle injury. Apparently there was some factor in the make up of this hybrid strain which was attractive to them, or perhaps it lacked some principle which in the other strains was repellent to them. We have not seen any references in tobacco literature to this selective taste of flea-beetles

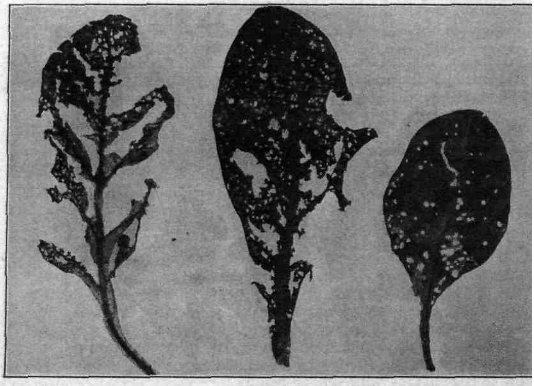

FIG. 12.—Lower tobacco leaves injured by flea-beetles.

for different kinds of tobacco. One grower of long experience states, however, that he has previously noticed this peculiarity. The worst cases of flea-beetle injury on the grown leaves which we have seen this year were on the edges of fields immediately adjacent to potato fields. After the potato tops died the beetles swarmed upon the tobacco and ruined the outside rows.

There is some question about the best method of controlling flea-beetles. In potato fields, they are kept in check by heavily spraying both upper and under sides of the leaves with Bordeaux mixture and lead arsenate. In the Station experiments many years ago, it was found that tobacco plants as well as tomato and cabbage plants could be dipped, root and leaf, before setting, into a mixture of lead arsenate, one pound in 10 gallons of water. This caused no injury to the plant and flea-beetles did not injure the leaves which were dipped. In the senior author's garden in 1925, one day when using a nicotine spray, it was noticed that

some tomato plants were being injured by flea-beetles. The plants were sprayed with nicotine (Black Leaf 40, 2 teaspoonfuls in a gallon of water with an inch cube of laundry soap dissolved

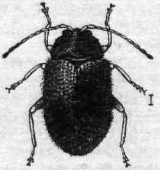

FIG. 13.—The cucumber flea beetle *Epitrix cucumeris*. (After Chittenden, Bureau of Entomology, U. S. Department of Agriculture.)

and added) and there was no further trouble. It is probable that all of the treatments mentioned act chiefly to repel the beetles instead of killing them.

THRIPS.

Thrips have never been considered among the serious insect pests of tobacco in Connecticut, but are said to cause severe injury in tobacco sections of the south. However, a number of cases were seen in Connecticut during the year, and there is an impression among the growers that they are becoming more prevalent each year in certain sections of the valley. Most, but not all, of the cases which came to our attention were in shade fields. It has also been observed in Florida that shade tobacco is more seriously affected than the sun-grown crop. This may be due to the fact that heavy rains do not beat them off under the shade cloth, as may be the case outside. It is said that they are worse during dry seasons and are partially kept in check by heavy rains. At the Tobacco Sub-station, the most serious infestation was on Havana seed, adjacent to the tent tobacco. The symptoms appear on the lowest leaves, and then slowly on the successively higher leaves. In this case, none were observed as high as the middle of the plants, and damage was confined to the first few leaves. In the field the veins of the affected leaves have a silvery appearance which makes them stand out from the remaining green tissue of the leaf. The insects work along the main veins on the upper leaf surface. Close examination shows the silver lines peppered over with tiny black specks. The insects themselves are not so often seen as are their effects. They are slender, brown, very small (about one twenty-fifth of an inch long) and when disturbed jump and disappear like fleas. Badly

affected leaves turn yellow and may die prematurely. In the cured leaf, the veins are still more conspicuous, and the average sorter calls it "white vein" without recognizing the difference between this and the ordinary "white vein" which usually occurs on leaves higher up, and which is of a physiological origin. Close examination, however, will show the distinctive tiny black specks and a rather irregular outline to the veins.

As we have made no collections of thrips from tobacco plants, we cannot identify the species attacking tobacco in Connecticut, but hope to obtain such information next season. *Thrips tabaci* Linde. is said to injure tobacco in Europe, but though it is a common pest of onions in Connecticut, so far as we can learn is not a tobacco pest in the United States.

Up to the present, thrips have not seemed to be of sufficient importance to warrant special control efforts. Attention is called to them at this time in order that growers will be on their guard and may know them if they should become serious. We have no reason to believe that they will become more prevalent.

THE GARDEN SPRINGTAIL.

Tobacco plants, as well as the young seedlings of many vegetable plants, are often attacked and injured in the seed beds by the garden springtail, *Sminthurus hortensis* Fitch. The individuals are extremely abundant near the surface of the soil when

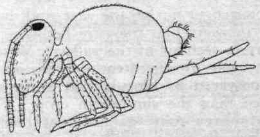

FIG. 14.—The garden springtail. Outline profile. This insect is purple with pale yellow irregular spots. Enlarged about 40 times.

the plants are coming up and eat very small holes in the leaves and enlarge the wounds made by flea-beetles and other insects. In fact, large areas of young seedlings are destroyed by the springtails, each year before their presence is noticed by the owner. They are scarcely more than a millimeter in length and it takes twenty of them end to end to reach an inch. They are dark purple, spotted with yellow, and jump like fleas so that it is almost impossible to catch them. Each has a globular shaped body with a rather large head and narrow neck. From beneath the body extends a forked tail-like appendage by means of which

the insect is able to throw itself. See Figure 14. Seed beds in Silver Lane, East Hartford, were infested in 1925. There were four beds each about 100 feet long and covered with cloth, and containing broadleaf plants from one-fourth to one-half inch high when attacked. All the beds were invaded and some had hardly any plants left. The junior author visited this plantation and also saw another less severe case in Simsbury. This insect caused much injury to vegetable seedlings in Pine Orchard in 1922 and 1923. The garden springtail can doubtless be controlled by dusting or spraying the seed beds with nicotine.

The Seed Corn Maggot.

Tobacco plants are occasionally injured by small white maggots which enter the stems just below the surface of the ground. Sometimes only a pin hole is visible, but often a larger injury is apparent. On cutting into the stem, one or more white mag-

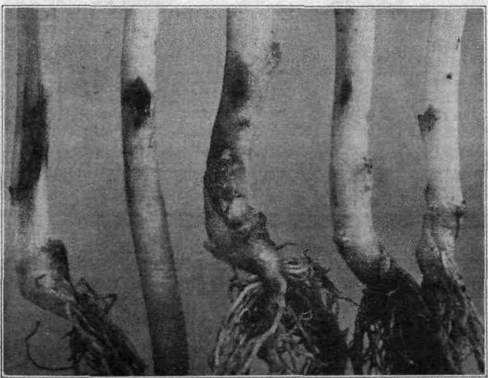

Fig. 15.—Stems of newly-set tobacco plants, showing injury by seed corn maggot. Twice enlarged.

gots may be found and sometimes the entire stem has been hollowed out by their feeding. Injured plants are shown in Figure 15. The insect responsible is a small two-winged fly, *Hylemyia cilicrura* Rond., shown in Figure 16, with its brown cocoons or

puparia in Figure 17. Serious injury to tobacco caused by this insect occurred in Windsor in 1921, particularly on a portion of the field where clover had been plowed under in the spring, and some 40 acres under cloth had to be harrowed and reset. This insect is liable to be abundant following heavy applications of stable manure.

During the first week in June, 1925, Mr. C. A. Huntington, a shade grower of Windsor, brought to the Tobacco Sub-station a handful of young plants, the stalks of which were riddled with

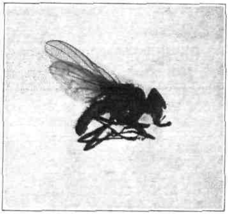

FIG. 16.—Adult of seed corn maggot. Four times enlarged.

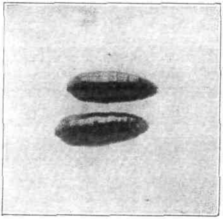

FIG. 17.—Pupae of seed corn maggot. Four times enlarged.

tunnels, somewhat resembling those made by wireworms, but when the stalks were cut open, small white maggots were found in the tunnels. These maggots attacked the plants soon after they were set in the field and killed many of them, necessitating considerable work in restocking. A week later they had disappeared completely, but in a visit to the field on June 5 we found a few puparia and were able to identify the invaders as seed corn maggots. No other report of damage from this source came to the Tobacco Sub-station this year. Apparently it is of unusual occurrence and does not cause widespread injury.

TOBACCO PLANTS INJURED BY CRANE FLY MAGGOTS.

The authors visited the shade field of Mr. Huntington of Windsor on June 5, and while hunting for seed corn maggots, found many "leather jackets" or crane fly larvae near the surface with an occasional pupa case protruding from the soil. Many plants were also observed with notches eaten in the stems, causing them to break off, that did not seem to be the characteristic injury of the seed corn maggot. The crane fly maggots

were often found near the plants, but were also present half way between the rows; in fact they were distributed quite uniformly over a portion of the field. On account of their abundance in that particular section of the field where the injured plants were found, we began to wonder if there might not be some connection. Mr. Huntington believed these maggots to be the cause of the trouble, and stated that so many plants were killed that it was

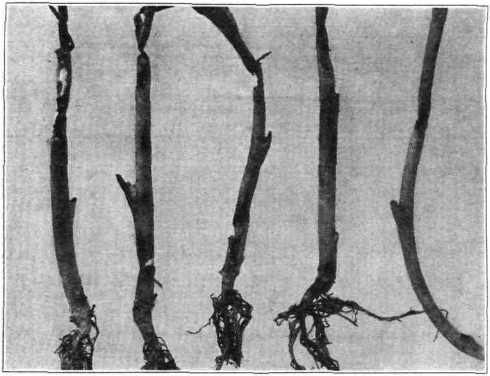

FIG. 18.—Injury to plants by crane fly larvae. Natural size.

necessary to harrow and reset certain parts of the field. Here the soil contained considerable undecomposed organic matter which may have served to attract these insects. A few adult crane flies were also collected from the cloth on the tent and from a tobacco barn close by. Before leaving the field, we collected about 30 of the larvae, which were taken to New Haven and placed in soil in a cage sunk in the ground. In this cage were set some uninjured tobacco plants. Three days later two of the plants had holes eaten in the sides of the stems like those observed in the tobacco field, and shown in Figure 18. On September 9, adult flies emerged and have been identified as *Nephrotoma ferruginea* Fabr., by Professor Charles P. Alexander of the Massachusetts Agricultural College, Amherst, Mass. These crane flies proved to be identical with those collected from the

cloth of the tent and from the tobacco barn, and belong to the family Tipulidae. The maggots are tough and leathery in texture, gray in color, about an inch in length with four curious protuberances at the head. There is probably a generation each

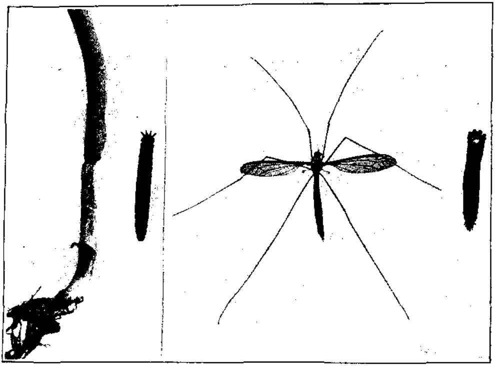

FIG. 19.—Adult crane fly, larva and pupa skin. Natural size.

year, and Figure 19 shows the maggot, pupa case, adult and injured plant.

According to the Insect Pest Survey Bulletin for July, similar injury to tobacco by crane fly maggots was observed in Hadley, Mass., by Dr. H. T. Fernald late in June of the past season. So far as we are aware, these are the first records of damage to tobacco by crane fly maggots, at least in this country. No control measures can be recommended at this time.

Tobacco Worms or Horn Worms.

Horn worms are the larvae or caterpillars of sphinx moths, also called hawk moths or hummingbird moths, which are found feeding on tobacco and tomato leaves during July, August and September. They are called horn worms on account of the single horn, which is only a flesby protuberance on the back near the

tail. When fully grown, they may be nearly as large as one's finger, between three and four inches in length, and have the appearance shown in Figure 20. They then enter the ground and transform into curious "jug-handle" pupae shown in Figure

FIG. 20.—Tobacco worms. Natural size.

21. There are two species in Connecticut, the northern tobacco or tomato worm, *Phlegethontius quinquemaculata* Haworth, and the southern tobacco or tomato worm, *Phlegethontius sexta* Johansen. The pupa of the northern species has the longer "jug-handle," and both are shown in Figure 21. The northern species is the more common in the tobacco fields north of Hartford, though the southern species is more common in the vicinity of New Haven. Horn worms are highly parasitized by small four-winged wasp-like insects and it is not unusual to find them covered with white cocoons as shown in Figure 22. In such cases the horn worm dies without transforming, but never before the crop of parasites has been brought through to maturity. It is uncertain whether more than one generation occurs in Connecticut, but if so, the second is not distinct from the first, and larvae of all sizes are often found in the field at the same time late in the

season. The adult moths have large heavy bodies with long narrow wings which expand between four and five inches as shown in Figure 23. They fly just at dusk, lay eggs singly on the tobacco plants and sip nectar from deep throated flowers by means

FIG. 21.—Pupae of both species showing difference in length of tongue cases. Northern species at the right.

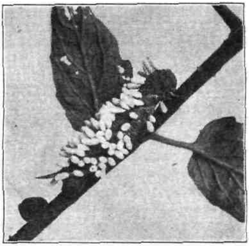

FIG. 22.—Young tobacco worm bearing cocoons of parasite.

of the long tongue which is coiled up like a watch spring under the head.

Hand picking is the common remedy in Connecticut, but in southern tobacco fields spraying and dusting with lead arsenate is commonly practiced.

GRASSHOPPERS.

Grasshoppers caused some damage to tobacco in 1925 by eating large holes in the leaves. They were especially prevalent along the margins of the fields which were adjacent to grass or other vegetation, upon which they feed. They were not of sufficient importance to warrant special control measures.

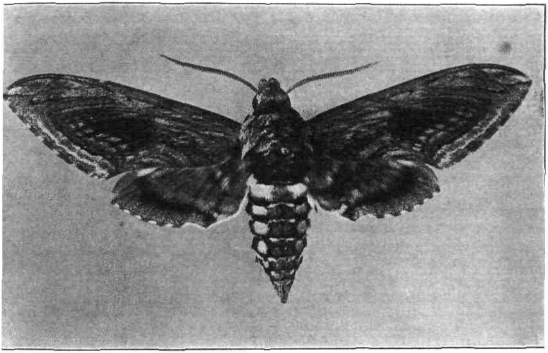

FIG. 23.—Moth of Northern tobacco worm *Phlegethontius quinquemaculata* Haw.

Bulletins

OF

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BULLETIN OF IMMEDIATE INFORMATION No. 51 — OCTOBER 1, 1925

Connecticut Agricultural Experiment Station
New Haven, Connecticut

REGULATIONS CONCERNING THE TRANSPORTATION OF NURSERY STOCK IN THE UNITED STATES AND CANADA

Compiled by W. E. BRITTON, State Entomologist.

At the present time nearly every State in the Union has laws or regulations in regard to the inspection, certification and transportation of nursery stock. These all have one object in view, namely, the control of plant pests. But conditions are not uniform throughout the United States, and each State has established such requirements as seem to give it the best protection, with the result that there are many different regulations.

This situation assumes a serious aspect to the nurseryman who may wish to fill orders received from eighteen or twenty or more different States. In order to tabulate and bring together these varying regulations in convenient form for the use of Connecticut nurserymen, this bulletin has been prepared. It should be understood that it presents only a brief digest in each case, and if any points are not clear, the nurseryman should write to the officer in charge of inspection in that State, for more information.

In addition to the various State laws and regulations, there are several Federal quarantines regulating the shipment of nursery stock. A digest of these has been included in this bulletin, together with the regulations of the District of Columbia and of the Dominion of Canada.

FEDERAL QUARANTINES

The following Federal Quarantines concern the shipment of nursery stock:

White Pine Blister Rust: Quarantine No. 26, as amended, prohibits the interstate movement of all five-leaved pines, currant

and gooseberry plants from all States east of and including Minnesota, Iowa, Missouri, Arkansas and Louisiana, to points west of this area; also prohibits the interstate shipment of five-leaved pines and black currant plants from the New England States and New York to points outside this area; further prohibits the shipment of five-leaved pines and black currant plants from the New England States into New York. Quarantine No. 54 as amended prohibits the movement of five-leaved pines, currant and gooseberry plants, from the State of Washington.

Black Stem Rust of Grains: Quarantine No. 38, as amended, prohibits the interstate movement of the common species of barberry and their horticultural varieties, except the Japanese barberry; also *Mahonia* from about three-fourths of the States.

European Corn Borer: Quarantine No. 43 (third revision, as amended) provides that the stalks of common host plants of the European corn borer (which include some herbaceous perennials) cannot be shipped interstate outside of the infested areas unless inspected and provided with a Federal certificate.

Gipsy Moth and Brown-Tail Moth: Quarantine No. 45, as amended, regulates the interstate shipment of all nursery stock, forest products, stone and quarry products from the infested area in the New England States, and from the generally infested to the lightly infested areas within those States. Nursery stock must be inspected and certified by Federal inspectors.

Japanese Beetle: Quarantine No. 48, as revised, regulates the interstate shipment of all nursery stock out of the infested area which includes certain portions of the States of New Jersey, Pennsylvania and Delaware. Such stock can be shipped only after it has been examined and certified by Federal inspectors.

Satin Moth: Quarantine No. 53, as amended, prohibits the interstate shipment from the infested areas in Massachusetts and New Hampshire of all species and varieties of willow and poplar.

For further information regarding Federal quarantines and regulations address: Federal Horticultural Board, U. S. Department of Agriculture, Washington, D. C.

District of Columbia

Each package of nursery stock entering the District must bear a valid certificate of inspection, must be marked "plants," with name and address of both consignor and consignee. No package

shall be delivered to the consignee until authorized by the inspector of the Federal Horticultural Board.

Federal quarantines prohibit the entry of all five-leaved pines and *Ribes* grown in the New England States, and the States of New York and Washington.

Federal Horticultural Board, Washington, D. C.

Dominion of Canada

Nursery stock from the United States can enter Canada only after a permit has been secured from the Secretary, Destructive Insect and Pest Act Advisory Board, Ottawa, Can. Applications must specify kind, quantity, value, source and destination of stock, with name and address of consignee and the customs port. All shipments must bear certificates of inspection, and where required, similar certificates of fumigation. Unless these certificates are attached, the shipments will not be released by the Collector of Customs. Plants exempt from fumigation requirements include greenhouse plants, roses grown under glass (up to three inches), herbaceous plants, strawberry plants, blackberry plants, grape vines, conifers, bulbs and corms, if accompanied by the consignor's certificate regarding contents of shipment. Fruit and nut scions are exempt only when forwarded under official labels requiring their reinspection at Montreal or Vancouver.

Quarantines prohibit the entrance of conifers and decorative plants (such as holly and laurel), and Christmas greens from New England: all five-leaved pines, chestnuts and chinquapin, all species of currants and gooseberries, European buckthorn and all varieties of *Berberis vulgaris*, all varieties of *Corylus* in British Columbia, all peach stock and fresh peaches from the States of Wisconsin, Illinois, Missouri, Arkansas, Mississippi and eastward to the Atlantic Ocean.

Arthur Gibson, Chairman; L. S. McLaine, Secretary, Destructive Insect and Pest Act Advisory Board, Department of Agriculture, Ottawa, Canada.

Postal Regulations Regarding Nursery Stock Shipped by Parcel Post

The U. S. Postal Laws and Regulations, Section 467, paragraph 2, governing the mailing of plants and plant products, reads as follows:

"Nursery stock, including all field-grown florists' stock, trees, shrubs, vines, cuttings, grafts, scions, buds, fruit pits and other seeds of fruit and

ornamental trees or shrubs, and other plants and plant products for propagation, except field, vegetable and flower seeds, bedding plants and other herbaceous plants, bulbs and roots, may be admitted to the mails only when accompanied with a certificate from a State or Government inspector to the effect that the nursery or premises from which such nursery stock is shipped has been inspected within a year and found free from injurious insects, and plant diseases, and the parcel containing such nursery stock is plainly marked to show the nature of the contents and the name and address of the sender."

State Regulations

FILING OF CERTIFICATES IN OTHER STATES

In order to ship nursery stock into the following States, it is necessary to file duplicate inspection certificates:

Alabama	Michigan	Oklahoma
Arkansas	Minnesota	Oregon
Connecticut	Mississippi	Pennsylvania
Florida	Missouri	South Carolina
Georgia	Montana	South Dakota
Illinois	New York	Tennessee
Indiana	New Mexico	Texas
Iowa	North Carolina	Utah
Louisiana	North Dakota	Virginia
Maryland	Ohio	Wisconsin
Massachusetts		Wyoming

Though not absolutely required by law, certificates may be filed in the following States:

Kansas	Kentucky	Nebraska

FILING OF BONDS

Bonds are required in the following States:

Arkansas	$1,000.00	Montana	$1,000.00	Oregon	$1,000.00
Georgia	1,000.00	North Dakota	500.00	Utah	500.00
Idaho	5,000.00	Ohio	1,000.00	Washington	1,000.00
Michigan	1,000.00	Oklahoma	1,000.00	Wyoming	500.00

Tennessee requires a bond of $5,000.00 where trees are planted by outside nurserymen under contract to prune and spray for a period of years.

PAYMENT OF FEES

The payment of fees is required for registration in certain States, as follows:

State	Registration Fee	Agent's Fee	State	Registration Fee	Agent's Fee
Alabama	$10.00	$1.00	Oklahoma	$5.00	
	(Dealer's)—	10.00	Oregon	10.00	$1.00
Arkansas	5.00	1.00	South Dakota	1.00	1.00
Georgia	5.00	1.00	Tennessee (Dealer's)		5.00
Idaho	10.00	1.00			1.00
Indiana	1.00	1.00	Texas	5.00	
Maine	5.00		Virginia	5.00	1.00
Michigan	5.00		Washington	5.00	1.00
Montana	25.00*		West Virginia	20.00	
North Dakota	10.00		Wyoming	15.00	
Ohio	5.00	1.00			

* Covering all Montana agents. Agents for unlicensed nurseries must pay annual fee of $10.00 and file bond of $1,000.00. Inspection fees $10.00 per car lot, smaller lots in proportion. Unlicensed nurseries, 10 per cent. of invoice price, with minimum of 50 cents per package.

FUMIGATION

All deciduous nursery stock subject to the attack of San José scale must be fumigated with hydrocyanic acid gas and labeled with a certificate or affidavit stating that this has been done before it will be allowed to enter the following States:

Colorado
Delaware
Florida
Michigan
Mississippi
North Carolina
Tennessee
Utah

STATE TAGS

State tags are required and will be furnished at the shipper's expense, by the following States:

Alabama
Arkansas
Florida
Louisiana
Mississippi
North Carolina
South Carolina
Virginia
West Virginia
Wyoming

Requirements of Various States.

Alabama: Nurserymen in other States wishing to ship stock into Alabama must obtain an Alabama license by filing a signed copy of inspection certificate, with fee of $10.00. Each package of nursery stock entering the State must bear an Alabama tag which is furnished at cost. Dealers must register, file list of all nurseries from which they purchase stock, pay fee of $10.00, and

obtain a dealer's certificate. An agent's certificate (cost $1.00) must be obtained through the principal for each agent selling nursery stock in Alabama. Nursery stock infested with San José scale, new peach scale, woolly aphis, brown-tail moth, gipsy moth, crown gall, black knot, citrus canker, peach yellows, pear blight, apple blotch, root nematode, peach borer, grape phylloxera or nut grass, must not be sold in Alabama.

B. P. Livingston, Chief, Division of Plant Industry, Montgomery, Ala.

Arizona: All nursery stock and plant products entering Arizona through the U. S. mails or transported in any manner shall be prominently labeled, showing (a) name and address of consignor; (b) name and address of consignee; (c) certificate of inspection; (d) locality where grown, and (e) contents of shipment. Common carriers shall not deliver to consignee any shipment of nursery stock or plant products until inspected by the State Entomologist or his agent and a certificate of release issued in each case to the common carrier and to the consignee. Postmasters are required to forward all parcels of nursery stock or plant products to the nearest Post Office Inspection Station, and cannot forward from these stations to point of destination any parcel of nursery stock or plant products unless accompanied by an inspected plant shipment tag.

Quarantines: Olive nursery stock and olive root cuttings from all other States and foreign countries are prohibited. Peach, nectarine or apricot trees or cuttings, grafts, scions, buds or pits, or trees budded or grafted upon peach stock from Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Pennsylvania, Delaware, Maryland, Virginia, Ohio, Indiana, Michigan, Illinois, West Virginia, Tennessee, North Carolina, Arkansas, Nevada, Florida, and Ontario, Can., and any other section in which peach yellows or rosette are known to exist are also prohihited.

O. C. Bartlett, State Entomologist, Box 348, Phoenix, Ariz.

Arkansas: In order to ship nursery stock into Arkansas, it is necessary (1) to file a nursery inspection certificate, pay a fee of $1.00 and secure a permit-certificate, and (2) every shipment into the State must bear a copy of the permit-certificate with chief inspector's facsimile signature, and tags must be purchased of the chief inspector.

Out-of-state nurserymen having agents or representatives soliciting orders, or doing other nursery business in Arkansas must (1) file a bond of $1,000.00, (2) pay $5.00 for a license to do business in the State, and (3) pay $1.00 for a license for each agent in the State.

Quarantines prohibit entrance of chestnut trees from all States east of the Mississippi River.

George G. Becker, Chief Inspector, Little Rock, Ark.

California: All shipments of nursery stock, plants, seeds, etc., into California, must be conspicuously marked with name and address of both consignor and consignee and declaration of contents and origin. All stock entering the State held until inspected.

Peach, nectarine or apricot trees or cuttings, grafts, scions, buds or pits of such trees, or any trees budded or grafted upon peach stock or roots from districts where contagious peach rosette is known to exist are refused entry and will be destroyed or returned to point of shipment at option of consignor and at his expense. The States known to be infected with this disease are as follows: Massachusetts, Rhode Island, Connecticut, New Jersey, Delaware, Maryland, Pennsylvania, West Virginia, Virginia, North Carolina, Tennessee, Kentucky, Mississippi, Ohio, Michigan, Indiana, Illinois, Arkansas, Nevada, Florida, and the Province of Ontario, Canada.

Quarantine order No. 36 prohibits entry of all five-leaved pines, currant and gooseberry plants from all States and districts east of and including Minnesota, Iowa, Missouri, Arkansas and Louisiana, and from the State of Washington. Quarantine order No. 38 prohibits entry of all trees, plants, grafts, cuttings or scions of all species and varieties of the cultivated filbert or hazelnut and American wild hazel (*Corylus americana*) from all States and districts east of and including Wyoming, Colorado and New Mexico. Quarantine order No. 43 prohibits entry of citrus trees and citrus fruits. Quarantine order No. 44 prohibits all chestnut and chinquapin (Castanea sp. and Castanopsis sp.) trees from all states east of east line of Idaho, Utah and Arizona. Pecan trees, hickory and Japanese walnut trees are prohibited from all states.

A. C. Fleury, Supervising Quarantine Officer, Sacramento, California.

Colorado: Each package of nursery stock entering the State must bear a certificate of inspection signed by a duly authorized inspector in the State from which it was shipped, and a certificate of fumigation signed either by an inspector or by the shipper of the nursery stock. On arrival, shipments are turned over to the County Inspector who in turn, if they pass inspection, releases them to the consignee.

Quarantines prohibit the entrance of the common barberry, white pines, currants and gooseberries, the potato tuber moth and alfalfa weevil.

C. P. Gillette, State Entomologist, Fort Collins, Colo.

Connecticut: Nurseries are inspected annually and nurserymen and dealers must register: nurserymen receive registration and inspection certificates and dealers receive permits. Out-of-state nurserymen must make application and file signed copies of their valid inspection certificates and receive permits before shipping stock into the State. All stock entering the State must be accompanied by both certificate and permit, and all stock transported within the States must be accompanied by either a certificate or by a permit, and transportation companies are subject to prosecution for accepting shipments without valid certificates or permits. Nursery stock imported from foreign countries must be held unopened until inspector arrives. Have authority to inspect any stock at destination.

Quarantine prohibits the shipment of all nursery stock and forest products, unless inspected and certified, from the gipsy moth infested area to the area uninfested.

W. E. Britton, State Entomologist, New Haven, Conn.

Delaware: Shipments of nursery stock entering the State must each bear a certificate of inspection and also a certificate stating that the stock has been properly fumigated. All shipments not provided with proper certificates will be held by the transportation companies until inspected.

Quarantines exclude all five-leaved pines and all species of *Ribes* from Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut, New York, Pennsylvania, Minnesota, Wisconsin, Ohio and Michigan.

Ralph C. Wilson, Secretary, State Board of Agriculture, Dover, Delaware.

Florida: In order to ship nursery stock into Florida, duplicate inspection certificates must be filed in Florida and permit-certificate tags obtained which, together with valid inspection certificates issued in the States where the stock was grown, must accompany each box, bundle or package. All host plants of San José scale must be fumigated with hydrocyanic acid gas of standard strength, immediately before shipment to a Florida point. Shipments of plants infected with nematode root knot, crown gall, hairy root or any insect pest or disease or markings thereof are excluded. Club orders entering Florida must have a Florida permit-tag attached to each individual order. When using a Florida permit-tag, the nurseryman must at once mail to the nursery inspector (Gainesville, Fla.) a duplicate invoice showing name and address of both consignor and consignee, itemized list of plants in shipment and serial number of Florida permit-tag used on it. All certificates on expiration and all mutilated, spoiled or unused permit-tags must be returned to the nursery inspector.

Shipments of stock liable to carry European corn borer, Japanese beetle, gipsy moth and brown-tail moth from areas under Federal quarantine for these pests will be admitted in Florida when accompanied by Federal inspection certificates, but are also subject to inspection by Florida authorities.

J. C. Goodwin, Nursery Inspector, State Plant Board, Gainesville, Fla.

Georgia: Each nurseryman, dealer, agent, salesman or solicitor must apply to the State Board of Entomology, giving (1) the name and location of the nursery, and (2) the approximate acreage and kinds of stock grown, and receive from the Board a license: annual fee for nurserymen and dealers $5.00: annual fee for each agent, salesman or solicitor $1.00. Where a sale amounts to $100.00 or over, a duplicate of the complete invoice (without price) must be filed with the State Board of Entomology, within thirty days of shipment, with the name and address of the salesman and of the purchaser, and name and quality of all nursery stock sold in the State or for delivery in the State.

All nurserymen, corporations, firms or individuals selling or offering to sell nursery stock in Georgia must file with the Board of Entomology, and maintain for three years, a bond of $1,000.00 made out to the Secretary of the Georgia State Board of Entomology.

Quarantines prohibit shipment into the State of all five-leaved pines, currants and gooseberries; all varieties of chestnut and chinquapin nursery stock, grafts, scions or nuts for propagation from infested States; and from all States infested with the Oriental peach moth, all trees, nursery stock, fruit, twigs, cuttings, scions and other parts of peach, apple, plum, quince, cherry and all other host plants of this insect, except apple fruit; all nursery stock from sections of states where Japanese camphor scale is present. Shipments of plants from areas infested by the Japanese beetle, European corn borer, gipsy moth and brown-tail moth admitted only in strict accordance with the requirements of the Federal quarantine.

Ira W. Williams, State Entomologist, State Board of Entomology, Atlanta, Ga.

Idaho: No person, firm or corporation shall import or sell nursery stock by agents within the State without first applying to the Department of Agriculture, filing a bond for $5,000.00 and obtaining an annual license by paying a fee of $10.00. All shipments into the State must show name of shipper, locality where grown, variety of nursery stock and an official certificate of fumigation from the State where the stock was grown. Imported

trees are fumigated before distribution, and all nursery stock shipped into the State must be inspected upon arrival at the expense of the consignee. Each nursery firm doing business in the State must annually pay an additional $1.00 for each agent. *Duplicate certificates should be filed.*

State quarantines exclude the entrance of all five-leaved pines, currants, gooseberries, peach, nectarine, prune, almond or other trees worked on peach stock and all pits, cuttings, buds or scions grown in a district where peach yellows or other detrimental diseases exist. There are special quarantines against the potato tuber moth and the alfalfa weevil.

M. L. Dean, Director, Bureau of Plant Industry, Boise, Idaho.

Illinois: Before shipping nursery stock into Illinois, a signed duplicate copy of the certificate of inspection must be filed with the Division of Plant Industry. Nurseries and dealers employing salesmen must file in the office of the Chief Inspector a complete list of such salesman representing them within the State, and apply, after July 1, for an agent's permit for each salesman employed in the State. All nursery stock entering the State must bear a valid certificate of inspection, names and addresses of consignor and consignee, nature of stock and place where grown. If stock arrives without such certificate it must be reported immediately to the Division of Plant Industry, and held until released.

Quarantine orders exclude from the New England States all five-leaved pines, all species and varieties of currants and gooseberries; common barberry (*Berberis vulgaris*) and all its horticultural varieties, and all species of *Castanea*. Stock shipped into Illinois in violation of quarantines is destroyed or returned to the consignor at the discretion of the owner.

P. A. Glenn, Chief Inspector, Division of Plant Industry, Urbana, Illinois.

Indiana: Nursery stock entering or shipped within the State must bear an official inspection certificate, and give the names of both the consignor and the consignee. All out-of-state nurseries must file with the State Entomologist a copy of their valid inspection certificate, pay $1.00, and obtain a license good for one year from date of issue, before shipping stock into the State. Each dealer and agent selling or soliciting sales of nursery stock in Indiana must pay $1.00, and obtain a license from the State Entomologist. All foreign grown stock must be inspected at destination.

Frank N. Wallace, State Entomologist, Department of Conservation, Indianapolis, Ind.

Iowa: Copy of inspection certificate must be filed with and approved by the State Entomologist, and must accompany each shipment into the State.

Quarantine against European corn borer prohibits all the usual host plants entering the State from the infested areas in Massachusetts, New Hampshire, New York, Pennsylvania, Ohio and Michigan.

Carl J. Drake, State Entomologist, Ames, Iowa.

Kansas: Nurseries are inspected annually and all certificates and dealer's permits lapse on June 1, following date of issue. Nursery stock may be shipped into the State when accompanied by a recognized certificate of inspection. Duplicate certificates may be filed.

Quarantine prohibits the entrance of five-leaved pines, currants and gooseberries from certain middle and eastern States.

O. F. Whitney, Secretary, Entomological Commission, Topeka, Kans.

Kentucky: Nurseries are inspected annually and each package of nursery stock entering the State must bear a certificate of inspection, list of contents, name of both consignor and consignee. Duplicate certificates may be filed with the State Entomologist.

H. Garman, State Entomologist, Lexington, Ky.

Louisiana: Before shipping nursery stock into Louisiana, application must be made to the Entomologist for permit by filing copy of valid certificate, and order for certificate tags accompanied by money to pay for them (price on application). The Louisiana tag and the inspection certificate of the State where the stock was grown must both accompany each shipment. A duplicate invoice must be filed with the Entomologist once a week, showing the permit number, and the number and varieties of plants shipped.

W. E. Anderson, State Entomologist, Department of Agriculture, Baton Rouge, La.

Maine: All individuals or firms selling or soliciting sales of nursery stock which they have not grown shall annually obtain a license from the State Horticulturist by paying a fee of $5.00. All stock entering the State shall bear on each box or package a valid inspection certificate; such stock may be inspected at destination and if found infested with dangerous pests may be destroyed or returned to the consignor.

Quarantine prohibits entrance of currant or gooseberry plants. Five-leaved pines cannot enter without a permit from the Forest Commissioner.

George A. Yeaton, State Horticulturist, Augusta, Me.

Maryland: Nurseries are inspected twice each year. Nursery stock subject to attack of San José scale must be fumigated before shipment. Shipments entering the State must bear certificates of inspection besides names of consignor and consignee. Duplicate certificate should be filed with State Entomologist.

Quarantines prohibit the shipment of five-leaved pines, currants and gooseberries from New York, the New England States, Pennsylvania, New Jersey, Michigan, Wisconsin, Minnesota and Washington; also into the non-infested counties of Maryland, of any nursery stock of peach or sweet cherry from areas infested with the Oriental peach moth.

Ernest N. Cory, State Entomologist, College Park, Md.

Massachusetts: All growers and agents who sell nursery stock for delivery within the State must have a grower's certificate or an agent's license, and a copy of such certificate or license must accompany each car, box or package of stock shipped or delivered. Agents must apply to Director, Division of Plant Pest Control, Boston, Mass., and file list of nursery firms from which they purchase stock before receiving agent's license. Authority is granted to inspect at destination all stock entering the State, and if found infested may be destroyed, treated, or returned to the consignor at his expense.

Quarantines prohibit *Ribes* from entering the State except under permit.

R. H. Allen, Director, Division of Plant Pest Control, Boston, Mass.

Michigan: Shipments of nursery stock entering the State must bear on each package a valid certificate of inspection, together with statement of contents and names of consignor and consignee; also if stock consists of species subject to attack of San José scale, it must have been fumigated with hydrocyanic gas and bear a certificate to that effect. Nurserymen of other States who employ agents to sell nursery stock in Michigan, must first file a bond of $1,000, pay a fee of $5.00, and obtain a license. Duplicate certificates must be filed before any stock can be shipped into the State.

Quarantines prohibit raspberry plants from entering the State unless they have had two inspections, one prior to July 31, and the other in August or September at least thirty days later; also five-leaved pines and black currants from New York and the New England States, though red and white currants and gooseberries may be shipped from the vicinity of Rochester, Geneva, Fredonia and Newark, New York, provided the white pine blister rust has not been found in the vicinity within two years. Neither barberry in any of its upright forms, nor sweet chestnuts grown east of Ohio, can be shipped into Michigan, and a quarantine against the

European corn borer prohibits the entrance from infested localities of the common hosts of that pest, including hardy perennials with stems.

L. R. Taft, Chief Horticulturist, Department of Agriculture, *Lansing, Mich.*

Minnesota: All nursery stock entering the State must bear valid certificates of inspection and any transportation companies accepting stock not so tagged are liable to prosecution. Outside nurserymen and dealers must file certificates with the State Entomologist before shipping stock into the State.

Quarantines prohibit the entry of all five-leaved pines and black currants from the New England States, New York, New Jersey, Pennsylvania, Ohio, Michigan and Wisconsin; other species of *Ribes* from these States are allowed to enter if stripped of leaves: all barberry except Japanese (*Berberis thunbergii*): the usual host plants of European corn borer.

A. G. Ruggles, State Entomologist, University Farm, St. Paul, Minn.

Mississippi: Outside nurserymen and shippers must file valid inspection certificates and obtain (at cost) permit tags, which together with inspection certificate of State where stock was grown, names and addresses of consignor and consignee, nature and quantity of contents, and locality where grown must be attached to each package. State certificate must also affirm that the nursery is properly equipped for fumigating plants with hydrocyanic acid gas, and the proprietor or manager of the nursery must file an affidavit that all host plants of San José scale will be fumigated immediately before being delivered for shipment into Mississippi.

Agents or salesmen must register with and obtain certificates from the Nursery Inspector before selling, delivering or taking orders for nursery stock in the State.

Plants infected with root knot (caused by nematodes), crown gall, or showing any other evidence of pest infestation, must not be shipped into Mississippi.

All plants capable of defoliation must be defoliated. Soft ornamental plants are classed as nursery stock in Mississippi.

Quarantines provide that nursery stock classed as host plants of the European corn borer and Japanese beetle can be shipped to this State from infested districts only when the shipments are made in conformity with the United States Department of Agriculture regulations and in addition are accompanied by permit tags of the State Plant Board of Mississippi.

Geo. F. Arnold, Nursery Inspector, A. and M. College, Mississippi.

Missouri: Outside nurseries must file necessary papers including certificate and apply for a permit certificate which will be issued with fee. All agents or salesmen must apply for agent's certificate. Each package of nursery stock entering the State must bear the names of both consignor and consignee, statement of contents, and a certificate showing that the stock therein contained has been inspected where grown by a duly authorized inspector and found to be apparently free from dangerously injurious insect pests and plant diseases. Transportation companies are not permitted to deliver nursery stock unless so labeled.

Leonard Haseman, State Entomologist and Chief Inspector, State Plant Board, Columbia, Mo.

Montana: All nursery stock entering the State must be unpacked and inspected at one of the following designated quarantine stations: Billings, Butte, Miles City, Missoula, Sanders or Fairview. All shipments entering the State are subject to inspection with fees as follows: licensed nurseries, car lots $10.00, smaller lots proportionate; unlicensed nurseries, ten per cent of invoice price of shipment with minimum of 50 cents per package. Notice of shipment including list of stock and names of transportation company, consignor and consignee must be sent to the Chief, Division of Horticulture, Missoula, Montana, five days prior to shipment.

Nurserymen are required to pay an annual fee of $25.00 and file a bond of $1,000.00 in favor of the State of Montana; this includes licenses for all Montana agents. Agents for unlicensed nurseries must pay an annual fee of $10.00 and file bonds of $1,000.00.

Quarantines prohibit the entrance of the common barberry from all States, and of all five-leaved pines, currant and gooseberry plants from the States east of and including Minnesota, Iowa, Missouri, Arkansas and Louisiana and all of the State of Washington.

Edward Dickey, Chief, Division of Horticulture, Missoula, Mont.

Nebraska: All nursery stock entering the State shall bear the names of consignor and consignee and an inspection certificate issued since the preceding July 1. It is desired that duplicate certificates be filed.

Quarantine prohibits the entrance of five-leaved pines.

Myron H. Swenk, State Entomologist, University of Nebraska, Lincoln, Neb.

Nevada: All nursery stock entering the State must bear on each car, bale, or package a copy of a valid official inspection

certificate, and names of consignor and consignee. Transportation companies shall not deliver nursery stock lacking such certificate.

Quarantine prohibits entry of any pine trees, currant or gooseberry plants or cuttings from east of the Mississippi River or from foreign countries.

Edward Records, State Quarantine Officer, University of Nevada, Reno, Nev.

New Hampshire: All nursery stock entering the State must bear on each container a copy of a valid inspection certificate, or an affidavit showing that susceptible plants have been fumigated.

Quarantines prohibit the entrance of all five-leaved pines, currant and gooseberry plants, except that such pines may be admitted if certified that no pine blister rust is known to occur in the nursery and that all *Ribes* had been removed from within 300 yards of the nursery; also that plants susceptible to attack of the European corn borer, gipsy moth and satin moth from infested regions cannot enter uninfested territory without inspection certificates.

W. C. O'Kane, Deputy Commissioner of Agriculture, Durham, N. H.

New Jersey: Each car or parcel of nursery stock entering the State must bear a copy of a valid inspection certificate, with a statement from the shipper that the contents are a part of the stock inspected and whether or not it had been fumigated with hydrocyanic gas. Transportation companies shall refuse for transportation within the State all nursery stock not accompanied by a certificate of inspection. All such stock entering the State may be inspected wherever found and if infested with dangerous pests, will be destroyed.

Common carriers and New Jersey nurserymen who bring nursery stock into the State shall send notice of each shipment with full data prior to, or within twenty-four hours after, its arrival.

Quarantines prohibit the entrance of five-leaved pines from all States where the pine blister rust occurs.

Harry B. Weiss, Chief, Bureau of Statistics and Inspection, State Department of Agriculture, Trenton, N. J.

New Mexico: Before shipping nursery stock into New Mexico, a duplicate copy of a valid certificate of inspection must be filed and a permit obtained.

Quarantine prohibits the entrance of *Ribes.*

H. L. Kent, President, Agricultural College, State College, N. Mex.

New York: Nursery stock cannot enter the State or be moved within the State unless a valid certificate is attached issued by the New York State Department of Farms and Markets or by the State in which the shipment originated. Transportation companies and all persons bringing nursery stock into the State must send notice to the Department of Farms and Markets. Blanks will be furnished for such notices. An exact copy of the certificate must be attached to each package sent by mail. Stock received from abroad or from other States must not be unpacked or distributed until after inspection and release by Department of Farms and Markets.

Quarantines prohibit the entrance of five-leaved pine trees from New England, New Jersey, Pennsylvania, Ohio, Indiana, Illinois, Wisconsin and Minnesota; also of Christmas trees and woody greens from New England, except from those areas lightly or not infested by gipsy moth and then only under certificates of inspection; of raspberry plants unless apparently free from mosaic diseases and are so certified after two inspections and the removal of all diseased plants, as is practiced in New York State; other regulations concern the European corn borer, and the usual host plants can be transported from within to without the infested areas only after being inspected and certified; currants and gooseberries cannot be grown in certain pine-growing areas of the State.

George G. Atwood, Director, Bureau of Plant Industry, Department of Farms and Markets, Albany, N. Y.

North Carolina: Nursery stock can enter the State only when shipments bear North Carolina official permit tags, which will be supplied at cost on request, and the filing of a duplicate inspection certificate accompanied by an affidavit that all fruit stock will be fumigated.

Quarantines prohibit the entrance of five-leaved pines and *Ribes* from Canada, the New England States, New York, New Jersey, Pennsylvania, Ohio, Wisconsin, Minnesota and Washington.

W. V. Reed, Inspector, State Department of Agriculture, Raleigh, N. C.

North Dakota: Nursery stock entering the State must bear inspection certificates. Every person employing agents or salesmen or who solicits for the sale of nursery stock, must obtain a license by paying a fee of $10.00, filing a duplicate inspection certificate, and a $500.00 bond. License is good for one year.

Director, North Dakota Experiment Station, Agricultural College, N. D.

Ohio: Out-of-state nurserymen must file copies of their inspection certificates and obtain an Ohio certificate permitting them

to solicit orders for nursery stock. Each dealer within or without the State shall obtain annually a dealer's certificate, by furnishing an affidavit that he will buy and sell only inspected stock and will maintain with the Secretary of Agriculture a list of all sources from which he obtains nursery stock. Each affidavit shall be accompanied by a fee of $5.00. All agents soliciting orders for nursery stock shall file annually a statement that he will sell only inspected stock, and pay a fee of $1.00. He shall carry an agents' certificate and a copy of the certificate held by his principal.

Each shipment entering the State shall be accompanied by a tag or poster giving an exact copy of the valid certificate. Altered certificates are prohibited.

Quarantines prohibit the entrance or shipment within the State of the common barberry and its horticultural varieties, and the common host plants of the European corn borer.

Richard Faxon, Chief, Division of Plant Industry, Department of Agriculture, Columbus, Ohio.

Oklahoma: Nursery stock entering the State must bear on each package of each shipment an inspection certificate. Nurserymen must each file a duplicate copy of his valid inspection certificate, and furnish a surety bond of $1,000.00 in favor of the State Board of Agriculture. A permit will be issued on payment of the fee of $5.00, and a copy of this permit must be attached to all shipments entering the State of Oklahoma.

All dealers within or outside the State must attach to each package of each shipment a copy of the dealer's certificate issued to them by the Board of Agriculture.

Thomas B. Gordon, State Nursery Inspector, Oklahoma City, Okla.

Oregon: The unlicensed sale or distribution of nursery stock is unlawful. The applicant must pay a fee and furnish a bond. The fee for a nurseryman, dealer or importer is $10.00, and for any agent, solicitor or salesman, $1.00. The bond shall be for $1,000.00 and shall be conditional that all stock delivered shall be true to name.

Quarantines prohibit the entry of all five-leaved pines and all species and varieties of currants and gooseberries from States east of the Mississippi River and from the State of Washington; of all hazel and filbert nursery stock from all territory east of the Province of Alberta, Canada, and the States of Idaho, Utah and Arizona; grape vines and cuttings from most of the eastern States and portions of California; cranberry nursery stock from the New England States, New York, New Jersey and Pennsylvania.

Chas. A. Cole, Secretary, State Board of Horticulture, Portland, Ore.

Pennsylvania: Nurserymen from outside the State must file duplicate copies of their valid inspection certificates, each certified by the State official in charge, and each non-resident nurseryman must supply a statement giving the exact acreage which he is growing in nursery stock and the acreage which is being grown for him under contract. Then a Pennsylvania certificate must be obtained before shipping stock into the State. Dealers are granted certificates on application and receipt of a statement from each that he will buy stock only from nurseries holding valid certificates of inspection. Agents soliciting for the sale of nursery stock in the State must obtain and carry agents' duplicate certificates. All shipments of nursery stock entering the State will be rejected unless accompanied by certificates of inspection.

Quarantines prohibit the entrance of chestnut trees, black currants, five-leaved pines, all barberry plants except Japanese barberry, and shipments of Christmas trees or woody greenery from the gipsy moth district of New England.

C. H. Hadley, Director, Bureau of Plant Industry, Harrisburg, Pa.

Rhode Island: All stock entering the State must bear a valid official certificate of inspection, but is subject to further inspection and may be destroyed or returned to the consignor if found infested. Agents must obtain agent's licenses, on stating where they expect to purchase their stock.

Five-leaved pines and *Ribes* can be shipped into the State or planted in certain parts of the State only on permission.

A. E. Stene, State Entomologist, State House, Providence, R. I.

South Carolina: Each package of nursery stock entering the State must bear a permit tag of the South Carolina State Crop Pest Commission, which may be obtained at cost by filing a duplicate certification of inspection and fumigation.

Quarantines prohibit the entrance of chestnut plants or cuttings, five-leaved pines, currants, gooseberries and all host plants of the European corn borer.

South Carolina State Crop Pest Commission, Clemson College, S. C.

South Dakota: Out-of-state dealers may obtain certificates permitting them to solicit and fill orders in the State, by filing with the Secretary of Agriculture a certified copy of their official inspection certificates and by paying a fee of $1.00 each. All agents shall likewise obtain and carry agents' certificates bearing copies of the certificates held by their principals, and paying fees of $1.00 each.

Quarantines prohibit the entrance of all five-leaved pines and *Ribes;* of all poplars and willows from areas infested by the satin moth; all host plants of the European corn borer.

B. F. Myers, Secretary of Agriculture, Pierre, S. D.

Tennessee: Out-of-state nurseries must file duplicate inspection certificates and the following agreement regarding fumigation:

> "We, the undersigned, agree to fumigate with hydrocyanic acid gas, according to the required strength, all nursery stock subject to attack from San José scale and other dangerous insect pests. We also agree to attach a fumigation tag to each and every shipment going into the State of Tennessee."

Every shipment must bear a valid inspection certificate and a fumigation tag, and failure to comply with these requirements subjects the stock to confiscation.

Nursery agents and dealers must file sworn statements on official Tennessee blanks which will be supplied. Each agent operating in Tennessee must pay a license fee of $1.00 and each dealer or jobber must pay $5.00.

Nurserymen selling trees under contract to prune and spray the same for a period of years are required to take out a bond of $5,000.00 before selling trees under such special contract.

State quarantines prohibit the entrance of all five-leaved pines, currants and gooseberries; all varieties of barberry except Japanese barberry; all varieties of chestnut and chinquapin from all States where chestnut blight occurs. Other restrictions apply to Japanese beetle, European corn borer, gipsy moth, sweet potato weevil and pink bollworm of cotton. Peach and pecan seedlings are allowed entrance only by special permit for experimental purposes.

G. M. Bentley, State Entomologist and Plant Pathologist, Knoxville, Tenn.

Texas: Nurserymen, florists and other shippers of nursery stock desiring to do business in Texas, must file with the Texas State Department of Agriculture a certified copy of certificate of inspection from the State Inspector of the State in which the shipment originates, and also in addition to this, a fee of $5.00 is required which must be remitted in post-office money order, cashier's check, or bank draft. This permit is good for one year, expiring on August 31 of each year.

All shipments of nursery and floral stock originating outside of the State must bear shipping tags showing the exact copy of certificate of inspection from the State Inspector of the State in

which the shipment originated, and in addition thereto must have a tag showing the exact copy of permit from Texas. These tags the shipper must have printed.

Texas freight and express companies are prohibited from receiving or delivering all shipments which do not bear proper tags, showing copies of necessary permits.

Nurserymen and florists of all States who ship nursery and floral stock into Texas, are requested to file with the Department of Agriculture a copy of invoice or memorandum of each and every shipment of stock made into the State, giving the date, consignor, consignee and a list of stock shipped. The price need not be given.

Those intending to ship orange and citrus seed of all kinds into Texas must furnish the Texas Department with a certified statement from their State Plant Board, that the seed was gathered from citrus-canker-free territory, and also an affidavit that the seeds to be shipped were treated in a corrosive sublimate solution of a strength of 1-1000.

Agents or dealers operating in Texas for nurserymen and florists outside of the State must procure proper credentials as agents from the nurserymen they represent. The form for this credential approved by the Commission of Agriculture is furnished free of charge. Each agent or dealer must be prepared to present such credential at all times.

Dealers are classed as nurserymen and are required to take out a permit. Greenhouses and greenhouse plants are included for inspection by the Texas laws and all State Inspectors should advise their nurserymen, florists or owners of greenhouses that they must have a Texas certificate before they can make shipments into the State of Texas.

G. J. Scholl, Chief Nursery Inspector, Department of Agriculture, Austin, Texas.

Utah: Out-of-state nurserymen must file with Board of Agriculture a valid official inspection certificate, and names of their agents in Utah, and obtain (without fee) an annual license; file a bond for $500.00 that they will comply with the law and to cover cost of inspection, fumigation, or destruction of stock shipped into the State or sold by their agents. Agents and salesmen representing out-of-state firms must carry proper credentials.

All nursery stock entering the State must bear a valid official inspection certificate and an official certificate that the shipment has been given a cyanide fumigation for 45 minutes at the rate of one ounce to each 100 cubic feet of enclosed space. Also a notice of each shipment giving duplicate invoice, list of contents, date, and names of both consignor and consignee must be mailed

to the State Agricultural Inspector. Any out-of-state shipment not bearing the proper license and certificate tags will be placed in quarantine and inspected and disinfected at the owner's expense.

H. J. Webb, State Agricultural Inspector, State Board of Agriculture, Salt Lake City, Utah.

Vermont: All nursery stock entering the State must bear valid official inspection certificates and the names and post office addresses of both consignor and consignee.

Quarantines restrict the free movement of raspberry plants on account of mosaic, leaf roll and rosette, hosts of the European corn borer, and all uninspected and non-nursery grown trees and forest products on account of the gipsy and brown-tail moths.

M. B. Cummings, State Nursery Inspector, Burlington, Vt.

Virginia: All nurseries must file valid inspection certificates, pay fee of $10.00 (checks must be certified and made payable to the Treasurer of Virginia) and obtain a certificate of registration; duplicates for agents' use $1.00 each. State tags will be furnished at cost and one must accompany each package of stock entering the State or sold within the State.

W. J. Schoene, State Entomologist, Blacksburg, Va.

Washington: No person shall sell, solicit sales, or distribute nursery stock, except berry plants, without first obtaining a license ($5.00 for nurserymen and tree dealers, $1.00 for agents). Nurserymen and dealers must file a bond of $1,000.00 for compliance with the law that the stock be true to name. All licenses expire July 1st. The State is divided into eleven horticultural districts, with an inspector-at-large in charge of each district. Notice of nursery stock entering Washington must be sent to the inspector-at-large into whose district the shipment is made, and a duplicate notice sent to the Department of Agriculture, Olympia, Wash.

J. I. Griner, Supervisor of Horticulture, Olympia, Washington.

West Virginia: All nursery stock entering the State must bear a valid certificate of inspection and a West Virginia permit tag. No nursery stock shall be sold, offered for sale or delivered, without first obtaining from the Commissioner of Agriculture, a certificate of registration, annual fee $20.00.

Quarantines prohibit the entrance of all five-leaved pines, and all species and varieties of gooseberries.

W. E. Rumsey, State Entomologist, Morgantown, W. Va.

Wisconsin: Each out-of-state nurseryman must file valid certificate of inspection and obtain State license before shipping stock into the State. Each car, or package, must bear certificate

tags. Each agent selling nursery stock in the State must carry an agent's duplicate certificate bearing the same number and date as that of his principal. No fees are charged.

Quarantines prohibit entrance of all five-leaved pines and all barberry bushes (except Japanese barberry) and host plants of European corn borer from infested areas; also nursery stock from gipsy moth infested areas except under Federal Certificate.

S. B. Fracker, State Entomologist, Madison, Wis.

Wyoming: Each out-of-state nurseryman must file valid certificate of inspection and deposit fee of $15.00 and receive license good until the following July 1st. Authorized shipping tags are furnished at cost, and carriers are forbidden to deliver unless each shipment bears such a tag.

Quarantines prohibit entrance of all five-leaved pines, currants and gooseberries.

C. L. Corkins, State Entomologist, Laramie, Wyoming.

OFFICERS IN CHARGE OF INSPECTION AND QUARANTINE SERVICE

Alabama ....B. P. Livingston, Chief, Division of Plant Industry, Auburn, Ala.

Arizona ....O. C. Bartlett, State Entomologist, Phoenix, Ariz.

Arkansas ....Geo. G. Becker, Chief Inspector, Little Rock, Ark.

California ....A. C. Fleury, Supervising Quarantine Officer, Sacramento, Cal.

Colorado ....C. P. Gillette, State Entomologist, Fort Collins, Colo.

Connecticut .....W. E. Britton, State Entomologist, New Haven, Conn.

Delaware ....Ralph C. Wilson, Secretary, State Board of Agriculture, Dover, Del.

Florida ....J. C. Goodwin, Nursery Inspector, State Plant Board, Gainesville, Fla.

Georgia ....Ira W. Williams, State Entomologist; Jeff Chaffin, Chief Inspector, State Board of Entomology, Atlanta, Ga.

Idaho ....M. L. Dean, Director, Bureau of Plant Industry, Boise, Idaho.

Illinois ....P. A. Glenn, Chief Inspector, Division of Plant Industry, Urbana, Ill.

Indiana ....Frank N. Wallace, State Entomologist, Indianapolis, Ind.

Iowa ....Carl J. Drake, State Entomologist, Ames, Iowa.

Kansas ....O. F. Whitney, Secretary, Entomological Commission, Topeka, Kans.

Kentucky ....H. Garman, State Entomologist, Lexington, Ky.

Louisiana ....W. E. Anderson, State Entomologist, Baton Rouge, La.

Maine ....Geo. A. Yeaton, State Horticulturist, Augusta, Me.

Maryland ....E. N. Cory, State Entomologist, College Park, Md.

Massachusetts ...R. H. Allen, State Nursery Inspector, State House, Boston, Mass.

Michigan ....L. R. Taft, Chief Horticulturist, Department of Agriculture, Lansing, Mich.

Minnesota ....A. G. Ruggles, State Entomologist, University Farm, St. Paul, Minn.

Mississippi ......Geo. F. Arnold, Nursery Inspector, Agricultural College, Miss.

Missouri ....Leonard Haseman, State Entomologist and Chief Inspector, State Plant Board, Columbia, Mo.

Montana ....Edward Dickey, Chief, Division of Horticulture, Missoula, Mont.

Nebraska ....Myron H. Swenk, State Entomologist, Lincoln, Neb.

Nevada ....Edward Records, State Quarantine Officer, University of Nevada, Reno, Nev.

New Hampshire..W. C. O'Kane, Deputy Commissioner of Agriculture, Durham, N. H.

New Jersey ......Harry B. Weiss, Chief, Bureau of Statistics and Inspection, State Department of Agriculture, Trenton, N. J.

New Mexico .....H. L. Kent, President, Agricultural College, State College, N. Mex.

New York ....Geo. G. Atwood, Director, Bureau of Plant Industry, Department of Farms and Markets, Albany, N. Y.

North Carolina ..W. V. Reed, Inspector, State Department of Agriculture, Raleigh, N. C.

North Dakota ...Director, Experiment Station, Agricultural College, N. D.

Ohio ....Richard Faxon, Chief, Division of Plant Industry, Department of Agriculture, Columbus, O.

Oklahoma ....Thomas B. Gordon, State Nursery Inspector, Oklahoma City, Okla.

Oregon ....Chas. A. Cole, Secretary, State Board of Horticulture, Portland, Ore.

Pennsylvania ....C. H. Hadley, Director, Bureau of Plant Industry, Harrisburg, Pa.

Rhode Island ....A. E. Stene, State Entomologist, State House, Providence, R. I.

South Carolina ..South Carolina State Crop Pest Commission, Clemson College, S. C.

South Dakota ....B. F. Myers, Secretary of Agriculture, Pierre, S. D.

Tennessee ....G. M. Bentley, State Entomologist and Plant Pathologist, Knoxville, Tenn.

Texas ....G. J. Scholl, Chief Nursery Inspector, Department of Agriculture, Austin, Tex.

Utah ....H. J. Webb, State Agricultural Inspector, State Board of Agriculture, Salt Lake City, Utah.

Vermont ....M. B. Cummings, State Nursery Inspector, Burlington, Vt.

Virginia ....W. J. Schoene, State Entomologist, Blacksburg, Va.

Washington .....J. I. Griner, Supervisor of Horticulture, Olympia, Wash.

West Virginia ...W. E. Rumsey, State Entomologist, Morgantown, W. Va.

Wisconsin ....S. B. Fracker, State Entomologist, Madison, Wis.

Wyoming ....C. L. Corkins, State Entomologist, Laramie, Wyo.

Federal Quarantines and District of Columbia ....Federal Horticultural Board, U. S. Department of Agriculture, Washington, D. C.

Dominion of Canada ....L. S. McLaine, Secretary, Destructive Insect and Pest Act Advisory Board, Department of Agriculture, Ottawa, Can.

BULLETIN OF IMMEDIATE
INFORMATION NO. 52

DECEMBER 15, 1925

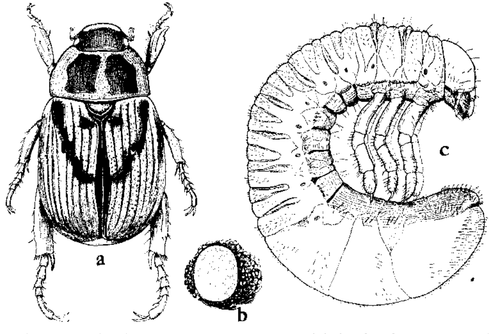
Connecticut Agricultural Experiment Station

New Haven, Connecticut

A New Pest of Lawns

W. E. BRITTON, *State Entomologist.*

For the past three seasons, lawns in a portion of the Westville section of New Haven have been injured by grubs eating the grass roots causing dead and brown patches—sometimes small and again 15, 20 or more feet in diameter. This damage was



The Asiatic beetle, *Anomala orientalis.* a. adult beetle. b. egg. c. grub or larva. All enlarged about five times.

much more conspicuous the past fall than it has been before, and many complaints and inquiries have been received at the Station concerning the matter.

The insect responsible for the injury is a small brown beetle of the family Scarabaeidae, known to science as *Anomala orientalis* Waterhouse. We have called it the Asiatic beetle to distinguish it from the green Japanese beetle, *Popillia japonica* Newm., which

is now established in southern New Jersey and eastern Pennsylvania. As near as can be determined, it was brought to New Haven in balls of earth on nursery stock from Japan, prior to 1917, when the Federal Horticultural Board prohibited all further importations of plants unless the soil had been removed from the roots.

DISCOVERY OF THE PEST.

A few of the beetles were taken by Messrs. Zappe and Walden, Assistant Entomologists of this Station, on July 16 and 21, 1920, in the nursery just south of Edgewood Avenue. They were pinned up and put away with other material. On July 26, 1921, a few more beetles were collected in the same locality. They were immediately recognized as belonging to the genus *Anomala*, but were different from any species in the Station collection or that we had ever seen. Specimens were then sent to Mr. Charles Schaeffer of the Brooklyn, N. Y., Museum, who at that time was studying the American species of *Anomala*. Mr. Schaeffer replied that he could not identify the species, but thought it was not a native and probably had been introduced from some other country. Later he sent specimens with other material to the British Museum of Natural History, where it was identified by Mr. Arrow as *Anomala orientalis*. Mr. Arrow reported it was a Japanese species which had been recorded as a destructive pest of sugar cane in the Hawaiian Islands, and stated that if it should get a foothold in the United States, it might possibly prove to be as injurious as the Japanese beetle in New Jersey.

This information came to the Station on May 17, 1922, and a few days later the information was sent to the Federal Bureau of Entomology for the Insect Pest Survey, and the facts were placed before the Federal Horticultural Board.

In the fall of 1922, a friend informed me that grubs had eaten the roots of the grass on his lawn so that it was dead in a small area perhaps four by eight feet. At first I supposed them to be common white grubs which are the larvae of May or June beetles, but on examination, they seemed smaller and more active. A number were gathered, placed in a small tin box with a little soil and taken to the laboratory. They nipped each other with their jaws and all died. The following spring more material was obtained; only a few were placed in each box with plenty of soil so that they could not injure each other. On July 24, 1923, the adults were obtained and proved to be identical with the specimens collected in that vicinity two and three years before.

DISTRIBUTION.

The insect is not known to occur anywhere else in the United States except in Westville, New Haven, where it seems to be restricted to the area bounded by Chapel Street on the south, West Elm Street on the north, and from Yale Avenue to Forest Street. Of course it may develop that the pest has been carried out of this area on the roots of plants or in transporting soil, but no such separate infestations have been discovered.

In the Orient, this species is present in Japan and Hawaii, but apparently it is a native of the Philippine Islands, whence it has been carried to Japan and Hawaii.

LIFE HISTORY AND HABITS.

The adult beetles emerge during July and the females lay eggs in the soil. These eggs hatch in a few days and the young grubs feed upon the grass roots within an inch of the surface. On the approach of cold weather, late in October, when about half-grown, they go deeper into the soil for protection from the cold, coming near the surface again in the spring to resume feeding. They become full-grown in June and pupate in cells in the soil. There is one generation each year, though a few of the larvae fail to transform the first year and run over into the second season. The adult beetles apparently fly and feed very little and usually are found in the turf or crawling upon the stems of grass or weeds. In Hawaii this pest caused much injury to sugar cane ten years ago, and a parasite, *Scolia manilae* Ashm., was imported with a view to controlling it. The parasite was successful and in two years reduced the numbers to such an extent that it was difficult to find any of the grubs in the sugar cane fields. This parasite has been brought to this country as a possible check to the Japanese beetle, but does not survive the winters in the vicinity of Philadelphia.

DANGER OF SPREAD.

The natural spread of this insect is not as rapid as might be the case were it a strong and active flyer. However, there is great danger of starting new colonies whenever rose bushes or other plants are carried with earth about the roots, or in carting away rubbish from the garden or surplus soil from grading, especially when carried to a point outside the infested area. Property owners and tenants are therefore cautioned against allowing any soil to be carried away from their premises. If allowed to spread southward, *Anomala orientalis* might become a serious pest of various crops.

CONTROL MEASURES.

The most promising control measures are treating the soil with something that will kill the grubs. Calcium cyanide and sodium cyanide, both dangerous poisons, have been used for this purpose. Either used at the rate of four ounces per square yard, and the ground well watered, will kill the grubs, but the vegetation will be injured. Carbon disulphide can now be made in the form of an emulsion which when applied to the soil will kill the grubs without injuring the grass and other vegetation.

ERADICATION RECOMMENDED.

At our request, specialists were sent from the Federal Bureau of Entomology to review the situation, and on October 29, 1925, Mr. Loren B. Smith in charge of Japanese beetle investigations, with Messrs. B. R. Leach and J. P. Johnson, all of Riverton, N. J., visited New Haven and inspected the infested territory. Soon afterwards, Mr. Smith submitted a report recommending that a co-operative attempt be made to eradicate the insect from this section. To do so is estimated to cost at least $25,000.00. Federal authorities expect that $10,000.00 will be raised in Connecticut. Probably a part of this amount will be available from State funds, and the City of New Haven may be asked to make an appropriation. The Edgewood Civic Association, through a special committee, asks property owners and residents to contribute towards this sum; tbey can afford to do so if there is a prospect of becoming rid of the pest altogether, and many have already expended modest sums on their own premises which will avail them little unless eradication measures are carried out over the whole area. The plans include treating the entire area with carbon disulphide emulsion under Federal and State direction and after the most approved methods.

In case the efforts are not immediately successful in eradicating this pest, they will surely reduce its numbers to such an extent that little damage will be done, and the danger of spread will be small in comparison with present conditions. We believe, however, that the chances for success are excellent. If prompt measures for extermination, in the light of our present knowledge, could have been carried out with such pests as the gipsy moth and the Japanese beetle, many millions of dollars might have been saved by the American people.

BULLETIN OF IMMEDIATE
INFORMATION NO. 53

APRIL 10, 1926

Connecticut Agricultural Experiment Station
New Haven, Connecticut

The Asiatic Beetle Quarantine

W. E. BRITTON, *State Entomologist.*

A new pest has appeared in the western or Westville section of New Haven in the form of a beetle, the grubs of which feed upon the roots of grass and probably other plants. This beetle is known to science as *Anomala orientalis* Waterhouse. We have called it the Asiatic Beetle to distinguish it from the Green Japanese Beetle, *Popillia japonica*, which now is present over some 6,000 square miles of territory in New Jersey, Pennsylvania and Delaware. *Anomala orientalis* is said to be a native of the Philippine Islands, but in some way it was introduced into Japan and also into Hawaii, where it has caused severe injury to the sugar cane crop. Many lawns have already been ruined in the Westville section of New Haven. As it is not known to occur elsewhere in the United States, and as it may prove a very serious pest here, especially if it should spread southward, every reasonable measure should be taken to eradicate it and prevent its further dissemination.

Following a hearing at the Station April 5, of which due notice was given, quarantine restrictions have been established by the following order:

STATE OF CONNECTICUT
AGRICULTURAL EXPERIMENT STATION
NEW HAVEN, CONN.

QUARANTINE ORDER NO. 8

CONCERNING ASIATIC BEETLE

Effective April 15, 1926.

It has been brought to my attention that a destructive insect pest known as the Asiatic beetle, *Anomala orientalis* Waterhouse, has been introduced into the western portion of the City of New Haven, and there is grave danger that this insect may be further spread or disseminated by transporting soil, turf, plants with soil about the roots, lawn clippings, rubbish, etc., from infested yards.

Therefore pursuant to the provisions of Chapter 107, Public Acts of 1925, I do hereby declare and order that the area bounded by Yale Avenue,

Willard Street, Forest Road, Cleveland Road, Central Avenue and Chapel Street, shall be a restricted area out from which, until further notice, the following materials will not be allowed to be moved except where treatment or inspection is practicable and permits issued by some person or persons authorized by me to issue such permits:

1. Soil or loam.
2. Plants with soil about the roots; plants in pots which have been set on or in the ground out of doors between June 1 and September 30, inclusive.
3. Turf or sod trimmings.
4. Lawn clippings.
5. Ground litter, weeds, manure or compost which has lain upon the ground.

This order does not affect such materials originating outside of and passing through the restricted area.

This order shall take effect April 15, 1926.

W. L. Slate, Jr.,
Director, Connecticut Agricultural Experiment Station.

Approved:
John H. Trumbull,
Governor.

On and after April 15, inspectors will be on duty in the infested area, to supervise the movement of such materials as are named in the quarantine order, scout around the infestations and later to treat the infested lawns.

The foregoing regulations do not constitute an embargo, and the movement of these materials will be prohibited only where there is great danger of carrying the pest into uninfested territory and where inspection or treatment is considered impracticable. Permits may be issued for the movement of such materials which are not in danger of carrying the insects or which may be rendered safe by inspection or treatment.

Headquarters will soon be established on West Elm Street, just east of Alden Avenue, where Mr. J. P. Johnson will be in charge of enforcing this quarantine and will supervise the treatment of all infested material. Applications for permits and information about the insect may be obtained at headquarters.

BULLETIN OF IMMEDIATE INFORMATION No. 54

OCTOBER 1, 1926

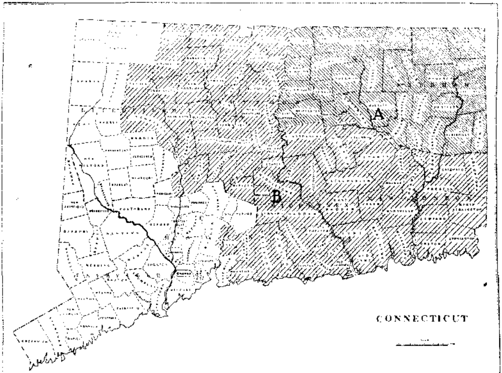
Connecticut Agricultural Experiment Station
New Haven, Connecticut

The Gipsy Moth Quarantine

(Revision Effective September 20, 1926)

W. E. BRITTON, *State Entomologist*

From time to time it is necessary to revise the gipsy moth quarantine to meet changing conditions and to bring it into harmony with the Federal quarantine. The Federal Horticul-



Map of Connecticut; shaded area quarantined on account of the gipsy moth; (A) Generally infested; (B) Lightly infested.

tural Board of the United States Department of Agriculture has recently revised the Federal quarantine relating to the gipsy and brown-tail moths (effective July 1, 1926). The authority for establishing quarantines in Connecticut (Section 2106 of the General Statutes) was amended by the last General Assembly,

Chapter 107, Public Acts of 1925, so that stone, quarry products, and other materials liable to carry dangerous pests may now be included instead of plant products only.

After due notice, a public hearing was held in Hartford on September 9, 1926, and the subject discussed. There was no opposition expressed. The preceding quarantine order relating to the gipsy moth became effective July 20, 1924. Seven towns then placed under quarantine are now released by the present order, namely: Salisbury, Canaan, North Canaan, Norfolk, Cornwall, Cheshire and Wallingford. The two areas (A) and (B) are shown on the accompanying map, and the quarantine order follows:

STATE OF CONNECTICUT
AGRICULTURAL EXPERIMENT STATION
NEW HAVEN, CONN.

QUARANTINE ORDER No. 9

CONCERNING GIPSY MOTHS

Inasmuch as it is necessary from time to time to revise the quarantine regulations, to protect the uninfested parts of Connecticut from danger of infestation by the Gipsy Moth, and as the Federal Horticultural Board has made such revision, effective July 1, 1926, and shown on a map published by the United States Department of Agriculture, whereon two areas are designated: (1) a generally infested area, colored red, and (2) a lightly infested area, colored green; by authority given in Chapter 107, Public Acts of 1925, I do hereby proclaim the same areas to be under State quarantine, as follows:

GENERALLY INFESTED AREA (A)

WINDHAM COUNTY:

All of the fifteen towns as follows:

Ashford	Hampton	Scotland
Brooklyn	Killingly	Sterling
Canterbury	Plainfield	Thompson
Chaplin	Pomfret	Windham
Eastford	Putnam	Woodstock

TOLLAND COUNTY:

The ten northernmost towns as follows:

Bolton	Somers	Union
Coventry	Stafford	Vernon
Ellington	Tolland	Willington
Mansfield		

HARTFORD COUNTY:

Five towns east of the Connecticut River as follows:

East Hartford	Enfield	South Windsor
East Windsor	Manchester	

LIGHTLY INFESTED AREA (B)

NEW LONDON COUNTY:

All of the twenty-one towns as follows:

Bozrah	Ledyard	Old Lyme
Colchester	Lisbon	Preston
East Lyme	Lyme	Salem
Franklin	Montville	Sprague
Griswold	New London	Stonington
Groton	North Stonington	Voluntown
Lebanon	Norwich	Waterford

MIDDLESEX COUNTY:

All of the fifteen towns as follows:

Chester	East Hampton	Middletown
Clinton	Essex	Old Saybrook
Cromwell	Haddam	Portland
Durham	Killingworth	Saybrook
East Haddam	Middlefield	Westbrook

NEW HAVEN COUNTY:

Seven towns as follows:

Branford	Meriden	Waterbury
Guilford	North Branford	Wolcott
Madison	North Haven	

TOLLAND COUNTY:

Three towns as follows:

Andover	Hebron	Columbia

HARTFORD COUNTY:

Twenty-four towns as follows:

Avon	Glastonbury	Rocky Hill
Berlin	Granby	Simsbury
Bloomfield	Hartford	Southington
Bristol	Hartland	Suffield
Burlington	Marlborough	West Hartford
Canton	New Britain	Wethersfield
East Granby	Newington	Windsor
Farmington	Plainville	Windsor Locks

LITCHFIELD COUNTY:

Ten towns as follows:

Barkhamsted	Litchfield	Thomaston
Colebrook	New Hartford	Torrington
Goshen	Plymouth	Winchester
Harwinton		

1. It shall therefore be unlawful to remove any woody nursery stock, trees, shrubs, lumber, cordwood, telegraph or telephone poles, railroad ties, Christmas trees, "Christmas greens," tree branches for decoration, or other forest plant products, or stone or quarry products, or any material likely to carry the gipsy moth, from the generally infested to the lightly infested area, or from either infested area to the non-infested area of the State, except under certificates or permits issued by authorized State or Federal inspectors.

2. In view of possible future changes in the lines between the generally infested, lightly infested, and non-infested areas of the State, the areas quarantined by the State shall conform to those quarantined by the Federal Horticultural Board of the United States Department of Agriculture; fur-

thermore, the Federal regulations covering interstate shipments of materials cited in Section 1 are hereby adopted for the regulation of shipments within the State of Connecticut.

3. This order shall take effect from its date.

Dated September 20, 1926.

W. L. SLATE, JR., *Director*,
Connecticut Agricultural Experiment Station.

Approved:
JOHN H. TRUMBULL,
Governor.

It will be seen that the present quarantine involves fewer towns than the preceding quarantine (Quarantine Order No. 6) and that it follows the Federal quarantine in dividing Connecticut territory into two parts (A), generally infested, and (B), lightly infested, these areas being colored red and green respectively on the Federal map. It also differs from Quarantine Order No. 6 in that it includes stone, quarry products, and any other materials liable to carry the gipsy moth.

MATERIALS AND PRODUCTS REQUIRING INSPECTION

The materials requiring inspection under both Federal and State quarantines may be roughly divided into four classes as follows:

1. **Christmas Greens and Decorations**:—Coniferous trees, such as spruce, hemlock, fir, pine, juniper or red cedar, arbor vitae or white cedar, or foliage thereof, and decorative plants such as holly and laurel or parts thereof known and described as Christmas greens or greenery.

Movement of materials in this class originating in the generally infested area (A) may be moved within the area without inspection, but will not be allowed to points outside of the area. If originating in the lightly infested area (B), they may be moved to other points in the same area or to points in the generally infested area (A) without inspection, but cannot be shipped outside the quarantined area without a Federal certificate or permit.

2. **Nursery Stock**:—Trees, shrubs, vines, cuttings, and florists' stock if woody and field-grown, but not including florists' greenhouse-grown stock or herbaceous plants.

Nursery stock grown within the generally infested area (A) may be moved within the area without inspection, but in order to move it to points within the area lightly infested (B) or to points outside the quarantine limits it must be accompanied by a certificate of inspection or permit issued by the United States Department of Agriculture. From points in the lightly infested area

(B) plants may be moved to other points in the same area or to points in the generally infested area (A) without inspection; to points outside the quarantined area a Federal certificate or permit is necessary. Regular nurseries must hold State inspection certificates or this Federal inspection may be refused.

3. **Forest Products**:—Logs, poles, posts, ties, car stakes, cordwood, lumber, tanbark, etc., but not including square-edged lumber direct from the saw, or lumber direct from the mills and finished on all faces, boxes, shooks, staves, etc., which have not been exposed to infestation by piling or storing out of doors.

Forest products may be moved between points within the generally infested area (A) and from points in the lightly infested area (B) to points within both areas without inspection; but must bear Federal certificates or permits if moved from within the generally infested area (A) into the lightly infested area (B) or from either area to points outside the quarantine limits.

4. **Stone and Quarry Products**:—Field stone, paving, building or monumental stone, etc., brick, tile, drain or sewer pipe.

Such materials may move between points in the same area or from points in the lightly infested area (B) to points in the generally infested area (A) without inspection; but from the generally *infested area (A) to points in the lightly infested area (B)* or from points in both areas to points outside the quarantine limits, they must be accompanied by Federal certificates or permits.

It is understood that most of these inspections will be made by Federal inspectors, but State inspectors are also qualified to make inspections and issue certificates. Each frequent shipper should procure a Federal map showing these areas in colors, and learn the name, address, and telephone number of the Federal inspector detailed to cover his locality. The Federal inspection service is in charge of

D. M. ROGERS, 408 Atlantic Avenue, Boston, Mass.

to whom applications for maps and inspections should be made.

The State inspection service is in charge of

W. E. BRITTON, Agricultural Experiment Station, New Haven, Conn.

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